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I. INTRODUCTION

The Central Shenandoah Valley Regional All Hazards Mitigation Plan was developed in accordance with the Disaster Mitigation Act of 2000 (DMA2K) and requirements of the Federal Emergency Management Agency (FEMA) Section 322 local hazard mitigation planning regulations. DMA2K was enacted on October 10, 2000, when President Clinton signed the Act (Public Law 106-390). The new legislation reinforces the importance of mitigation planning and emphasizes planning for disasters before they occur. As such, this Act establishes a pre-disaster hazard mitigation program and new requirements for the national Hazard Mitigation Grant Program (HMGP). States and local governments are required to adopt hazard mitigation plans in order to qualify for pre- and post- disaster federal hazard mitigation funding.

The purpose of the plan is to identify natural hazards that impact the region and to offer mitigation strategies that will lessen the effects that these hazards have on the citizens, property and businesses in the region. The plan was developed on a multi-regional basis which included the five counties of Augusta, Bath, Highland, Rockbridge, and Rockingham, the five cities of Buena Vista, Harrisonburg, Lexington, Staunton, and Waynesboro and the eleven incorporated towns which include Glasgow, Goshen, Craigsville, Grottoes, Bridgewater, Broadway, Dayton, Elkton, Mt. Crawford, Timberville and Monterey.

The planning process was led by the Mitigation and Planning Work Group of the Shenandoah Valley Project Impact and supported by staff of the Central Shenandoah Planning District Commission. The Hazard Identification Risk Assessment (HIRA) was prepared by Virginia Tech's Center for Geospatial Information Technology.

Funding for the development of the plan was provided in large part through a grant from the Virginia Department of Emergency Management with matching funds provided by the Central Shenandoah Planning District Commission.

II. PLANNING PROCESS

The planning process actually began back as early as 1995 when local government officials recognized a void in flood planning and prevention after the devastating floods in 1995 and 1996. They called on the Central Shenandoah Planning District Commission (CSPDC) to develop a local mitigation strategy and offer planning and technical assistance to abate future damages.

For the next several years and the next few flood events, the CSPDC assisted many of the localities in identifying at-risk properties, applying for state and federal funds, and administering flood mitigation projects. Since 1995, the CSPDC has secured nearly $10,000,000 in federal, state and local funds to elevate, move, acquire or floodproof 173 structures and provide a disaster education and mitigation program in our region.

In 1999 the Region began looking at ways to prevent floods from becoming disasters through a viable planning process with effective public input. A committee comprised of elected officials, local government staff and private citizens as well as technical experts from the various natural resource agencies was created to assess the problem, review possible solutions and recommend actions for the Region to take.

Led by the Central Shenandoah Planning District Commission, the committee met over the course of a year and half to produce the Central Shenandoah Valley Regional Flood Mitigation Plan. The Plan addressed the flood hazards that put each of our 21 communities at risk. The Plan identified and illustrated flood risks and the history of flooding. It described the projects and efforts that localities have implemented to reduce flood damage and more importantly it explains what still needs to done. The Plan offered sound, viable mitigation options and offered guidance and options for dealing with floods, setting priorities and effectively planning to minimize future damage and protect floodplain resources.

From there the region was directed by FEMA and the Virginia DEM to look at other natural hazards that impact the central Shenandoah Valley. The Flood Mitigation Committee that was created back in 1999 to oversee the Central Shenandoah Regional Flood Mitigation Plan was called back into action to address the requirements of the Disaster Mitigation Act of 2000. In the meantime, the Central Shenandoah Region became a Project Impact Community. The purpose of Project Impact was to develop a sustainable long-term program of disaster-resistance education in the Shenandoah Valley. The Central Shenandoah Project Impact structure is made up of a steering committee and 4 work groups: 1) Mitigation and Planning; 2) Business Continuity, 3) Public Awareness and 4) Special Populations. Under this structure the former Flood Mitigation Committee was reinstated and reorganized and became Project Impact's Mitigation and Planning Workgroup. The purpose of this committee was to promote mitigation methods that protect homes, public buildings, critical facilities, and natural spaces in the Shenandoah Valley.

The main task of the Mitigation and Planning Workgroup was to develop the All Hazards Plan. The Mitigation and Planning Workgroup was comprised of elected officials, city, county, and town staff, business persons, and interested citizens. All local jurisdictions were involved in the planning process either through direct representation on the committee or through involvement with Shenandoah Project Impact.

Others involved throughout the planning process included representatives of local government, nonprofit organizations, human service agencies, the business community, universities and colleges, local libraries, the Red Cross, and other organizations interested in disaster mitigation. These persons served on the Project Impact/Citizen Corps Council and met on a regular basis throughout the development of the plan.

Mitigation and Planning Committee Members

Name	Title/Organization
Robbie Symons	Chief of Fire & Rescue/Rockingham County
John Lively	Citizen, Highland County
Tom Higgins	County Engineer/ Rockbridge County
Kyle O'Brien	Town Manager/Broadway
Sam Blackburn	Mayor/Glasgow
Gary Critzer	Emergency Operations Director/Waynesboro
Sharon Angle	City Planner/Staunton
Thomas Sliwoski	Director of Public Works/Staunton
Sherry Ryder	Planner/Bath County
Candy Hensley	County Engineer/ Augusta County
Sam Crickenberger	Director of Planning/Rockbridge County
Tracey Shiflett	Director of Community Development/Buena Vista
Tom Bailey	Zoning Technician/Augusta County
Hadley Jenner	County Planner/Rockingham County
Basil Finnegan	Town Engineer/Bridgewater
David Nichols	GIS Manager/Bridgewater
Billy Via	Vice-Mayor/Goshen
Matt Smith	City Engineer/Harrisonburg
Jason Debord	Construction Manager/Engineering Concepts
Drew Havens	Town Manager/Glasgow
Sam Hoddinger	GIS Manager/Harrisonburg

The Mitigation and Planning Committee met over the course of 3 years to develop the plan. Below is a list of the meeting dates, agenda topics, and number of attendees.

Mitigation and Planning Committee Meetings

Date	Topic/Agenda	Attendees
September 17, 2002	• Distributed "Understanding Your Risks" – FEMA guidance document • Distributed Hazard Response Survey to Committee Members • Presentation on Community Rating System	16
December 3, 2002	• Project Impact Up-date • Multi-Hazard Plan Presentation • Citizen Corps	13
January 21, 2003	• Reviewed Results of Hazard Response Survey • Discussed Map Modernization Program	14
March 18, 2003	• Conducted "brainstorming" exercise to select and prioritize hazards • Developed citizen input survey	9
May 20, 2003	• Presentation on Wildfires/Wildfire Mitigation • From Boyd Ritchie, Va. Department of Forestry • Distributed citizen input survey	15
July 15, 2003	• Virginia Corps/Citizen Corps Council Presentation • Mitigation Workgroup Status Report • Disaster and Mitigation Library Collection	30
September 16, 2003	• Scheduled/planned Vulnerability Assessment Training for public utility providers	11
November 18, 2003	• Presentation on Hurricanes and Wind Mitigation from Jon Ayscue, FEMA Region III • Presentation and discussion of Hurricane Isabel	17
December 2, 2003	• Hurricane Isabel Up-date • Virginia Corps/Citizen Corps Council/CERT	35
March 16, 2004	• Presentation on tornadoes, anti-terrorism, and disaster education for persons with disabilities	19
June 15, 2004	• Presentation on karst topography, sink holes, drought by Terri Brown, Terrane Environmental Co.	19
September 21, 2004	• Presentation on Hurricane Camille and 2004 hurricane season • Presentation on HAZUS	12
November 16, 2004	• Up-date on CERT • Special Needs-Post Hurricane Survey Results • Presentation by Institute for Infrastructure and Information Assurance – Homeland Security • HIRA Presentation – Dr. Shane Parson, Virginia Tech	22
January 26, 2005	• Up-date on Tsunami Disaster • Identifying Critical Structures • Disaster Preparedness for Special Populations	13
March 15, 2005	• Historical Winter Storms Report • All-Hazards Plan Mitigation Strategies • JMU Preparedness Guide	22
June 21, 2005	• Amateur Radio and Disasters • Citizen Corps Update • HIRA Results Presentation • JMU Preparedness Guide	23
July 27, 2005	• Public Meeting and Review/Adoption Process	7

Staff Training - Throughout the course of the planning process, staff and committee members attended workshops, training, and conferences related to the development of the All Hazards Plan as well as sponsored a number of training workshops for the public.

Training Attended by Staff/Committee

Date	Workshop/Conference	Sponsor/Location
July 29-Aug. 2, 2002	NFIP-CRS Training	FEMA-Emmitsburg, MD
August 19-21, 2002	Fire and Life Safety Educators Conference	FLSEC – Staunton, VA
November 19-20, 2002	VDEM Emergency Preparedness Outreach Conference	Richmond, VA
November 21-22, 2002	Living with Nature: Pre-disaster Mitigation Conference	Roanoke Project Impact - Roanoke, VA
January 23, 2003	Virginia Floodplain Management Association Workshop	VFMA – Abington, VA
March 7, 2003	All-Hazards Training	VDEM – Radford, VA
March 12-14, 2003	Va. Emergency Management Conference	VEMA, VDEM – Williamsburg, VA
March 25-26, 2003	Flood Fight Course	VDEM - Waynesboro, VA
April 29-May 1, 2003	Environment Virginia Conference	DEQ, VMI – Lexington, VA
May 6, 2003	Flood Mitigation Workshop	VFMA, DCR – Harrisonburg, VA
May 30-31, 2003	Shenandoah Valley Watershed Conference	Pure Water 2000 – Harrisonburg, VA
June 22-25, 2003	CERT Training	FEMA, VDEM – Emmitsburg, MD
August 1-3, 2003	Fire & Life Safety Educators Conference	VAFLSE – Alexandria, VA
November 19-21, 2003	Va. Public Safety Outreach Conference	VDEM, Virginia Citizen Corps – Richmond, VA
March 30-31, 2004	HMGP/BCA Training	VDEM, Staunton, VA
May 16-21, 2004	Association of State Floodplain Managers Annual Conference	ASFPM - Biloxi, MS
May 26-27, 2004	Managing Hazard Mitigation Grants Workshop	VDEM/FEMA – Richmond, VA
June 16-18, 2004	Virginia Mitigation Summit	UVA, VCU, VDEM – Charlottesville, VA
August 18-19, 2004	Va. Housing Rehab Conference	DHCD – Charlottesville, VA
September 14-17, 2004	HAZUS Training	FEMA – Emmitsburg, MD
September 15, 2004	All-Hazard Planning	VDEM, FEMA – Roanoke, VA
September 21, 2004	Citizen Corps Council Regional Meeting	Roanoke, VA
November 17 - 18, 2004	Public Safety Outreach Conference	VDEM – Richmond, VA
March 26, 2005	Medical Reserve Corps Workshop	JMU – Harrisonburg, VA
April 15, 2005	Citizen Corps Council Regional Meeting	Roanoke, VA
May 2 – 4, 2005	Emergency Management Course	Rockingham County – Harrisonburg VA
May 9, 2005	JMU Research Symposium	JMU – Harrisonburg, VA

Training Sponsored by Project Impact – Mitigation and Planning Workgroup

Date	Workshop	Location
August 16, 2002	SVPI/VAZO Building Disaster Resistant Communities	Harrisonburg, VA
October 8, 2002	Disaster Planning for People with Special Needs	Staunton, VA
April 9, 2003	NFIP Insurers Workshop	Staunton, VA
May 6, 2003	Floodplain Management Workshop	Harrisonburg, VA
November 15, 2003	Emergency Operations Planning Workshop	Staunton, VA
May 11, 2004	Emergency Operations Planning Workshop	Staunton, VA
January 28, 2004	Vulnerability Assessment Training for Utility Providers	Weyers Cave, VA
November 9-11, 2004	Emergency Planning for Persons with Special Needs – FEMA Course G197	Staunton, VA
June 21, 2005	Amateur Radio Presentation and Workshop	Staunton, VA

III. PUBLIC PARTICIPATION

Fortunately for the Central Shenandoah Region, we were designated a Project Impact Community by FEMA in 2000. Under the Project Impact umbrella we were able to reach and educate thousands of citizens and business regarding disaster preparedness and mitigation. Through Project Impact numerous opportunities were made available to gather public input into the planning process. More than 40 presentations were made to civic groups, human service organizations, and other groups working with citizens (young and old) in the Valley. Educational materials were distributed to hundreds of citizens at most of these events and presentations. In January 2003, the Central Shenandoah Region became a Citizen Corps Council enabling the region to continue the work and programs initiated by Project Impact. Listed below are just a few of the events and venues where the general public was given the opportunity to learn more about disaster preparedness, mitigation, and the multi-hazard plan. In addition, the Mitigation and Planning Workgroup developed a survey, to gather written responses to gauge the public's knowledge of tools and techniques that assist in reducing risk and loss from natural disasters and to gauge household preparedness for disasters. This survey was distributed to Project Impact members, their contacts, CERT members, and at many of the events listed below. Sixty-two (62) surveys were returned and tabulated. Comments from these surveys have been incorporated into this document as appropriate. See survey instrument and survey results attached.

A public meeting was held on July 27, 2005 to allow the public to comment on the draft All Hazards Plan and to gather input from citizens into the planning process. The meeting was announced through local media. (See public notice announcements and agenda attached).

In addition, a copy of the draft plan was posted on the website of the Central Shenandoah Planning District Commission – www.cspdc.org to allow the general public to comment on the plan and have input into the planning process.

Public Involvement Activities

DATE	EVENT	LOCATION
September 3, 2002	Presentation to Waynesboro Kiwanis	Waynesboro, VA
September 7, 2002	Display at Children's First Day	Harrisonburg, VA
November 14, 2002	Presentation for Virginia Department of the Deaf and Hard of Hearing	Staunton, VA
November 26, 2002	Presentation to Rockingham Rotary Club	Harrisonburg, VA
February 10, 2003	TV interview – "Reach Out" Program	Harrisonburg, VA
June 18, 2003	Presentation to Craigsville Elementary Summer School	Craigsville, VA
July 2, 2003	Presentation to Riverheads Elementary Summer School	Augusta County, VA
July 8, 2003	Presentation to Cassell Elementary Summer School	Augusta County, VA
July 22, 2003	Presentation to Gypsy Hill House Residents	Staunton, VA
July 24, 2003	Presentation to Rockbridge Area Community Service Board	Lexington, VA
August 5, 2003	Display at National Night Out	Staunton, VA
October 5-10, 2003	Fire Prevention Week Display	Staunton, VA
October 12, 2003	Waynesboro First Aid Crew – Open House	Waynesboro, VA
October 27, 2003	Flood Preparedness Presentation	Bath County, VA
November 12, 2003	"Too Much Weather" presentation to Millboro Group Home	Bath County, VA
December 18, 2003	Presentation to Bath/Highland Disability Serve Board	Highland County, VA
March 2, 2004	"Too Much Weather" presentation to VCSB Day Program	Staunton, VA
March 9, 2004	Presentation to regional VDOT staff	Rockingham County, VA
May 22, 2004	Display at Glasgow EMS Day	Glasgow, VA
July 7, 2004	Spanish language preparedness display at Valley View Trailer Park	Harrisonburg, VA
July 9, 2004	Disaster preparedness activity at Boys and Girls Club	Harrisonburg, VA
July 22, 2004	CERT presentation to Community Watch Group	Glasgow, VA
July 27, 2004	Disaster preparedness presenta-tion to Animal Hospital staff	Waynesboro, VA
July 29, 2004	Flood Mitigation Presentation	Vesuvius, VA
July 31, 2004	Safety Day Disaster Display	Rockingham County Fair Grounds
August 3, 2004	Disaster preparedness display at National Night out	Staunton, VA

September, 4, 2004	Disaster preparedness display at Children First Day	Harrisonburg, VA
September 11, 2004	Disaster preparedness display at Augusta Fire Rescue Appreciation Day	Verona, VA
September 25, 2004	Animal preparedness display at Pets in the Park	Staunton, VA
October 4-8, 2004	Fire prevention kiosk for Fire Prevention Week	Staunton, VA
October 15, 2004	Disaster preparedness workshop for staff at Massanutten Library	Harrisonburg VA
October 16, 2004	Disaster preparedness display for Vesuvius Day	Vesuvius, VA
October 17, 2004	Historic flood lecture at Massanutten Library	Harrisonburg, VA
January 18, 2005	Disaster preparedness presentation to Rotary Club	Staunton, VA
March, 2 2005	Disaster preparedness presentation to Western State Hospital	Staunton, VA
March 10,2005	Disaster preparedness presentation for Mint spring Ruritan Club	Augusta County, VA
April 16, 2005	Disaster preparedness display for Civilian Air Patrol Training	Waynesboro, VA
April 27, 2005	Disaster preparedness presentation Senior Group	Harrisonburg, VA
May 7, 2005	Display at Kid Matters Day	Staunton, VA
May 16 – 20, 2005	Hurricane Preparedness Week display at mall	Staunton, VA
June 6, 2005	Disaster preparedness presentation for Disability Services Board	Waynesboro, VA
July 7, 2005	Disaster preparedness presentation for Senior Center	Harrisonburg VA
July 18, 2005	Disaster preparedness presentation for Mosby Court Apartment Complex	Harrisonburg, VA

Another avenue used to reach the public and gain their input into the planning process was through the Community Emergency Response Team (CERT) program. CERT is a national program offered through FEMA. The goal of CERT is for emergency personnel to train members of neighborhoods, community organizations or workplaces in basic response skills like disaster preparedness, fire safety, emergency first aid and crime prevention. The Central Shenandoah Planning District began offering CERT classes in September 2003. Since then there have been 11 classes held throughout the region resulting in a total of 166 volunteers trained in CERT.

IV. HAZARD IDENTIFICATION RISK ASSESSMENT (HIRA)

1. Purpose

In accordance with the requirements of the Disaster Mitigation Act of 2000, communities must conduct a hazard identification risk assessment (HIRA). Having the HIRA in place allows local jurisdictions in the planning district to better understand local hazards and the risks posed by them, begin to develop mitigation activities to lessen the impacts and, to acquire disaster-related grants in the aftermath of a disaster. The HIRA was developed to serve as a guide to all communities in the planning district when assessing potential vulnerabilities to natural hazards. When developing this section, every effort was made to gather input from all aspects of the project area communities to assure that the results of this analysis were as accurate as possible.

The planning area for this study includes the 21 jurisdictions of the Central Shenandoah Planning District. All jurisdictions located in this district have been included in this portion of the study, as this analysis has been completed on a regional basis. It should be noted, however that a local jurisdiction's inclusion in the full Mitigation Plan is dependent on the community's participation in the remainder of the planning process.

The purpose of the HIRA is to:

1. Identify what hazards that could affect the Central Shenandoah Planning District
2. Profile hazard events and determine what areas and community assets are the most vulnerable to damage from these hazards
3. Estimate losses and prioritize the potential risks to the community

Methodology for Identifying and Prioritizing Hazards

One of the first steps in the planning process and the hazards identification risk assessment phase was to identify each of the hazards that can occur and impact the region. This hazard identification began with a review of previous hazard events based on historical data provided through previous studies and reports, existing plans and resources. In addition extensive research was conducted by the staff of the CSPDC and Virginia Tech on hazards reported through the newspapers for the last century. In addition, members of the Mitigation and Planning Workgroup participated in a group exercise to assist with the identification and priorities of hazards. Survey results collected from the general public were also used to identify and prioritize hazards.

The hazards were ranked to determine what hazards are most likely to impact the communities of Central Shenandoah PDC. The hazards that were determined to have significant impact were analyzed in the greatest detail to determine the magnitude of future events and the vulnerability for the community and the critical facilities. Hazards that

received a moderate impact ranking were analyzed with available data to determine the risk and vulnerability to the specified hazard. The limited impact hazards were analyzed using the best available data to determine the risk to the community.

The findings from these steps were used to identify and prioritize the hazards in our region and are the focus of the mitigation strategies developed in this plan. The following hazards were identified and are described in detail below:

- Floods
- Winter Storms
- Hurricanes
- Wildfires
- Tornadoes and Windstorms
- Drought
- Land Subsidence, Karst Topography and Sinkholes

Project Study Area and Planning District Description

The Central Shenandoah Valley Region is located in the middle of the historic and scenic Shenandoah Valley in west-central Virginia. With a land area of 3,439 square miles, the Region is home to some 246,400 persons. Geographically, the Region is the largest planning district in the state.

The Region is comprised of five counties (Augusta, Bath, Highland, Rockbridge, and Rockingham) and five independent cities (Buena Vista, Harrisonburg, Lexington, Staunton, and Waynesboro). The Region also has 11 incorporated towns within its borders: Glasgow and Goshen in Rockbridge, Craigsville and portions of Grottoes in Augusta, Bridgewater, Broadway, Dayton, Elkton, Mt. Crawford, Timberville and portions of Grottoes in Rockingham and Monterey in Highland.

The Region is bounded on the east by the crest of the Blue Ridge Mountains and on the west by the elevations of the Allegheny Mountains and the West Virginia border. Of the Region's 2.2 million acres of land, approximately 1.2 million acres are publicly held and protected. The headwaters of the James, Shenandoah, and Maury rivers are located in the Region.

Bisected by Interstate 81 on the north-south axis and by Interstate 64 on the east-west axis, the Region is approximately 45 miles north of Roanoke, 100 miles west of Richmond, 125 miles southwest of Washington, D.C., 68 miles south of the Virginia Inland Port, and 200 miles northwest of the Port of Hampton Roads.

According to the 2000 U. S. Census, there were 97,763 housing units in the Region of which 70.4 were owner-occupied. The median value of the housing units in the Region was $68,446. The three top employment sectors in the Region are manufacturing employing 24.3 of the workforce; trade sector with 23.6 of the workforce, and services with 20.6 of the workforce.

The Region is part of the Valley and Ridge Physiographic Province, which is characterized by gently rolling and hilly valleys, as well as gradual mountain slopes. The extreme eastern edge of the Region is within the Blue Ridge Physiographic Province which is distinguished by mountain peaks. The western edge of the Region is characterized by high, narrow, mountain ridges that run northeast to southwest forming relatively narrow river valleys. Elevations range from a high of 4,546 feet above sea level in Highland County to a low of 720 feet above sea level near Glasgow in Rockbridge County.

Soils in the valley range from carbonate soils to alluvial soils along rivers and streams. Colluvial soils resulting from the weathering of the sandstone and shale mountains are found in the foothills paralleling the valley. The mountain areas are covered with shallow, rocky, excessively drained soils that derive from the weathering of acidic sandstone, shale, quartz, and granite parent material. The predominant geological structure underlying the Region is a complex formation of limestone, calcareous shale, and dolomite, with smaller amounts of sandstone, conglomerate, and chert.

The Region is blessed with a high quality and quantity of natural resources, made evident by the large proportion of the each county that is held as national forest and park land. Much of the forested area in the Region is within either the Shenandoah National Park or the George Washington-Jefferson National Forest. Forest resources are important in maintaining the local forestry industry, watersheds, wildlife habitats, and outdoor recreation. The dominant forest type in the Region is mixed hardwoods, specifically oaks, hickories, and maples.

Surface water in the Region drains into two separate basins, the Shenandoah River basin in the north and the James River basin in the south. The ridge dividing the two watersheds is located in southern Augusta County. The major waterways in the Region are the North and South Forks of the Shenandoah River, North River, South River, Middle River, Jackson River, Bullpasture River, Cowpasture River, and Maury River. Many of these major waterways are used as public supply sources. Normal water flow in the larger water courses generally provides ample supplies, but impoundments are required to maintain adequate reserves during droughts. Lake Moomaw in Bath County, with a surface area of 2,530 acres was created in 1979 with the completion of the Gathright Dam on the Jackson River.

Table 1 and Figure 1 illustrates the land area of each of the communities in the planning district as well as the populations in the community and number of households. Approximately half of the region's land is publicly owned and protected. This information will prove to be a key component in determining the risk to communities from natural hazards.

Table 1
Central Shenandoah Planning District Commission Demographics
(From US Census Bureau)

County values include all unincorporated and incorporated areas, including towns.

NAME	Area (Sq Mile)	2000 Pop	2000 Pop per Sq Mile	2003 Pop	Median Home Value	Total Housing Units
Augusta County	970	65,615	67.64	67,427	$110,900	24,818
Craigsville, Town of	1.945	979	503.34	1,012	$64,800	474
Bath County	532	5,048	9.49	5,013	$79,700	2,053
Buena Vista City	7	6,349	907	6,320	$72,900	2,547
Harrisonburg City	18	40,468	2,248.22	41,170	$122,700	13,133
Highland County	416	2,536	6.10	2,504	$83,700	1,131
Monterey, Town of	0.304	158	519.74	150	$84,200	141
Lexington City	2	6,867	3,433.50	7,076	$131,900	2,232
Rockbridge County	600	20,808	34.68	20,973	$92,400	8,486
Glasgow, Town of	1.488	1,046	702.96	1,018	$66,400	494
Goshen, Town of	1.711	406	237.29	398	$59,100	214
Rockingham County	851	67,725	79.58	69,365	$107,700	25,355
Bridgewater, Town of	2.361	5,203	2203.73	5,301	$126,300	1,850
Broadway, Town of	1.795	2,192	1221.17	2,429	$101,100	976
Dayton, Town of	0.798	1,344	1684.21	1,345	$120,600	565
Elkton, Town of	1.377	2,042	1482.93	2,038	$94,800	919
Grottoes, Town of	0.037	2,114	57135.14	2,166	$90,500	894
Mt. Crawford, Town of	0.345	254	736.23	284	$96,700	109
Timberville, Town of	0.875	1,739	1987.43	1,703	$82,300	770
Staunton City	20	23,853	1,192.65	23,848	$87,500	9,676
Waynesboro City	15	19,520	1,301.33	20,388	$89,300	8,332

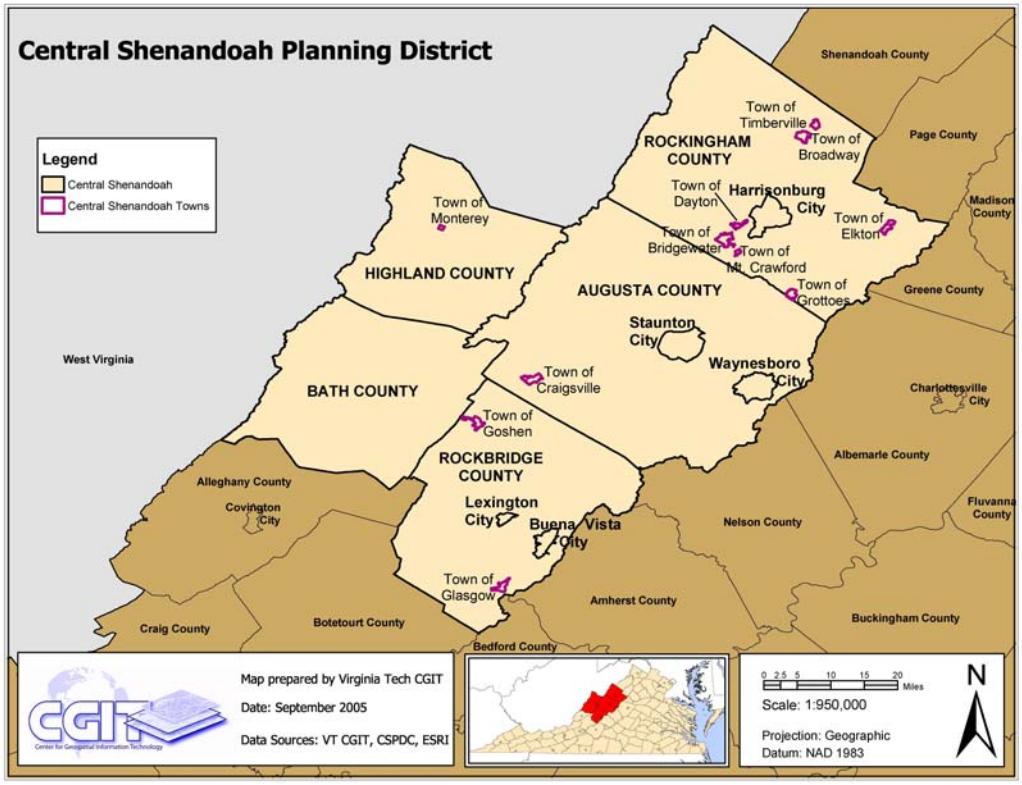

Figure 1 - Central Shenandoah PDC Boundaries.

Watersheds

The major watersheds for the Central Shenandoah PDC include the Potomac River Basin to the northeast and the James River Basin to the southwest. The Rappahannock River Basin boarders the eastern tip of Rockingham County and the Roanoke River Basin is in close proximity to the southern tip of Rockbridge County. The headwaters of the James, Shenandoah, and Maury Rivers are located within the region. The following Figure 2 illustrates the location of the major watershed boundaries for the planning district.

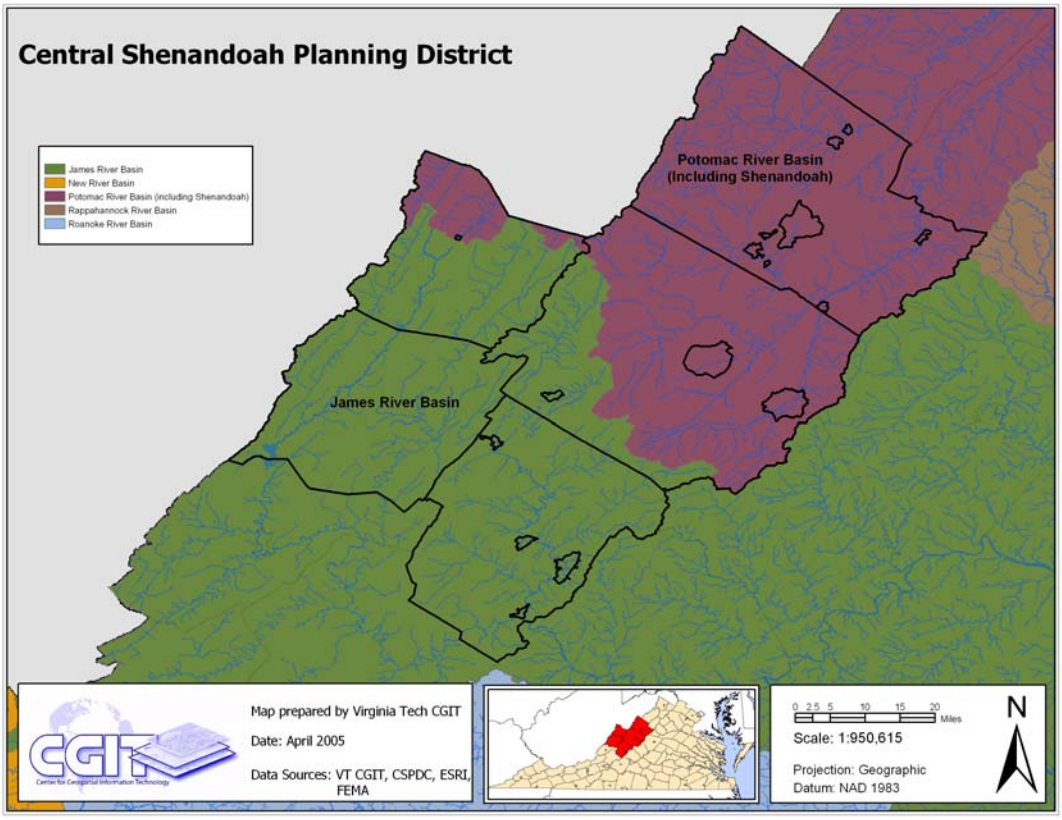

Figure 2 - Central Shenandoah PDC Watersheds (from VA-DCR).

Critical Facilities

According to the FEMA State and Local Plan Interim Criteria, a critical facility is defined as a facility in either the public or private sector that provides essential products and services to the general public, is otherwise necessary to preserve the welfare and quality of life in the local jurisdiction, or fulfills important public safety, emergency response, and/or disaster recovery functions.

Critical facilities for CSPD were derived from a variety of sources. Information provided by the PDC was supplemented with ESRI data as well as geocoded facilities completed at the Virginia Tech Center for Geospatial Information Technology (CGIT). Analysis for the region was completed using the best available data. Census blocks were used to assess the areas vulnerability to specific hazards. Flooding analysis was conducted in a slightly different manner. Critical facility points were intersected with the floodplain data for the region. Structure value was established using average house value in the 2000 Census data. The 2000 Census data for average structure value per block was used as a replacement cost in the event of a disaster. This value can serve as a guide in assessing the impacts of various hazards. Figure 3 shows the locations of critical facilities in the region.

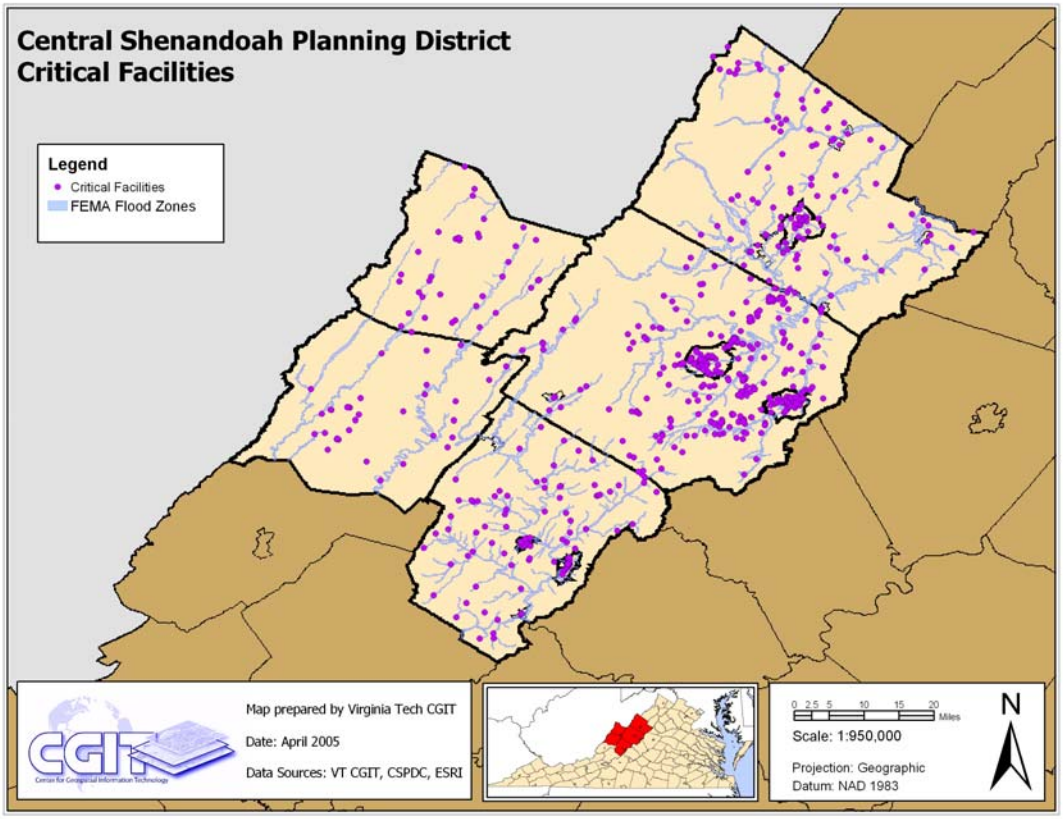

Figure 3 - Central Shenandoah PDC Critical Facilities.

Data Limitations

Inadequate information posed a problem for developing loss estimates for most of the identified hazards. The limiting factor for the data was the hazard mapping precision at only the jurisdiction level. Many of the hazards do not have defined damage estimate criteria.

Available data for this plan was very limited. The FEMA guidelines emphasize using "best available" data for this plan. The impact of these data limitations will be shown through the different vulnerability assessment and loss estimation methods used for hazards.

Critical facilities were determined based on best available data. Critical facilities, residential and industrial buildings within the 100 year floodplain were identified for flood analysis (CSPD Flood Mitigation Plan). The HAZUS-MH model was used to estimate damage from hurricanes in the Central Shenandoah region.

GLOSSARY

A-Zone – an area that would be flooded by the Base Flood, and is the same as a Special Flood Hazard Area (SFHA) or a 100-year floodplain. A-Zones are found on all Flood Hazard Boundary Maps and Flood Insurance Rate Maps (FIRMS).

Acquisition – Removal of structures from the floodplain through purchase and demolition with the property to be forever maintained as open space.

Aftershock – an earthquake of similar or lesser intensity that follows the main earthquake.

Alluvium – Sand, mud and other material deposited by a flowing current.

Annual Flood – The flood that is considered the most significant flood event in a one-year cycle of a floodplain.

Backwater – Rise in water caused by downstream obstruction or restriction or by high stage on an intersecting stream. Also referred to as "heading up."

Base Flood – Sometimes referred to as a 100-year flood, it is a flood of the magnitude that has a one percent chance of occurring in any given year.

Base Flood Elevation (BFE) – Elevation of the 100-year flood. This elevation is the basis of the insurance and floodplain management requirements of the National Flood Insurance Program.

Basin – The largest watershed management unit. A basin drains to a major receiving water such as a large river, estuary or lake.

Benefits – Future losses and damages prevented by a project.

Benefit Cost Analysis (BCA) – An assessment of project data to determine whether or not the cost of the project is justified by its benefits.

Berm – Small levees, usually built from fill dirt.

Blizzard Warning – winds or frequent gusts to 35 miles per hour or greater and considerable falling or blowing snow expected to prevail for a period of three hours or longer.

Buffer – Vegetated strips of land surrounding ecosystems.

Buyout – Commonly used term for property acquisition.

Catchment – The smallest watershed management unit. The area that drains an individual development site to its first intersection with a stream.

Channel – A natural or artificial watercourse with definite bed and banks to confine and conduct flowing water.

Check Dam - A small, low dam constructed in a gully or other watercourse to decrease the velocity of stream flow, for minimizing channel scour.

Community Rating System (CRS) – A system, administered by FEMA, where communities are recognized for their mitigation efforts that exceed the NFIP's minimum standards for floodplain regulation. NFIP policyholders in the community are rewarded with reduced annual flood insurance premiums as part of this project.

Confluence – The section where one stream joins another stream.

Crest – The maximum stage or elevation reached or expected to be reached by the water of a specific flood at a given location.

Critical Facility – Facilities that are critical to the health and welfare of the population and are especially important following hazard events. Critical facilities include, but are not limited to, shelters, police and fire stations, and hospitals.

Debris/Debris Flow – Materials (broken bits and pieces of wood, stone, glass, etc.) carried by wind or floodwaters, including objects of various sizes.

Declaration – Presidential finding that a jurisdiction of the United States may receive Federal aid as a result of damages from a major disaster or emergency.

Design Wind Speed Map – a map of the United States development by the American Civil Engineers that depicts wind zones based on frequency and strength of past tornadoes and hurricanes.

Development – Any man-made change to improved or unimproved real estate, including, but not limited to, buildings or other structures, mining, grading, paving, excavation or drilling or storage of equipment or materials.

Digitize – To convert points, lines and area boundaries shown on maps electronically into coordinates for use in computer applications.

Disaster Resistant Communities – A community based initiative that seeks to reduce vulnerability to natural hazards for the entire designated area through mitigation actions. This approach requires cooperation between individuals and the business sectors of a community to implement effective mitigation strategies.
Drought - a period of abnormally dry weather that persists long enough to produce serious effects like crop damage, water supply shortages, etc.

Dry Floodproofing – Protecting a building by sealing its exterior walls to prevent the entry of flood waters.

Earthquake – a sudden slipping or movement of a portion of the earth's crust accompanied and followed by a series of vibrations

Elevation – The process of raising a house or other building so that it is above the height of a given flood to minimize or prevent flood damage.

Emergency – Any hurricane, tornado, storm, flood, high water, wind-driven water, tidal wave, tsunami, earthquake, volcanic eruption, landslide, mudslide, snowstorm, drought, fire, explosion, or other catastrophe in any part of the United States which requires Federal emergency assistance to supplement State and local efforts to save lives and protect property, public health and safety, or to avert or lessen the threat of a disaster.

Emergency Operations Plan (EOP) – Sets forth actions to be taken by State or local governments in response to emergencies or major disasters.

Encroachment – Any physical object placed in a floodplain that hinders the passage of water or otherwise affects flood flow, such as landfills or buildings.

Epicenter – the area of the earth's surface directly above the origin of an earthquake.

Erosion – The process of the gradual wearing away of land masses during a flood or storm or over a period of years through the action of wind, water or other geologic processes.

Fault – an area of weakness where two sections of the earths crust have separated.

Federal Emergency Management Agency (FEMA) – An independent agency of the Federal government established in 1979, reporting to the President. FEMA's mission is to reduce loss of life and property and protect our nation's critical infrastructure from all types of hazards through a comprehensive, risk-based emergency management program of mitigation preparedness, response and recovery.

First Floor Elevation – The elevation of the lowest finished floor of a structure.

Flash Flood – A sudden, violent flood that rises quickly and usually is characterized by high flow velocities. Flash floods often result from intense rainfall over a small area, usually in areas of steep terrain with little or no warning where water levels rise at an extremely fast rate.

Flood – A partial or complete inundation of normally dry land areas from 1) the overland flow of a lake, river, stream, ditch, etc.; 2) the unusual and rapid accumulation or runoff of surface waters; or 3) mudflows or the sudden collapse of shoreline land.

Flood Control – Measures taken to keep the flood waters away from specific developments or populated areas by the construction of flood storage reservoirs, channel alterations, dikes and levees, bypass channels, or other engineering works.

Flood Depth – Height of the floodwater surface above the ground surface.

Flood Duration – The length of time a stream is above flood stage or overflowing its banks.

Flood Frequency – A statistical expression referring to how often a flood of a given magnitude can be expected. (Note: the word "frequency" often is omitted to avoid repetition).

Examples:

- 10-year flood – the flood which can be expected to be equaled or exceeded on average once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.
- 50-year flood - …. two percent chance…in any given year.
- 100-year flood - …. one percent chance…in any given year.
- 500-year flood - ….two-tenths percent chance…in any given year.

Flood Fringe – The portion of the floodplain that lies beyond the floodway and serves as a temporary storage area for floodwaters during a flood.

Flood Insurance Rate Map (FIRM) – An official map of a community prepared by FEMA on which areas that may or may not require flood insurance are delineated. These maps also provide flood elevations and velocity zones.

Flood Insurance Study (FIS) – A study prepared by FEMA that provides an examination, evaluation, and determination of flood hazards and, if appropriate, corresponding water surface elevations in a community or communities.

Flood Mitigation Assistance Program (FMA) - Provides pre-disaster grants to State and local governments for both planning and implementation of mitigation strategies. Each State is awarded a minimum level of funding which may be increased depending upon the number of NFIP policies in force and repetitive claims paid.

Floodplain – Land adjoining a stream (or other body of water) which has been or may be covered with water.

Floodplain Management – The operation of an overall program of corrective and preventive measure for reducing flood damage, including but not limited to emergency preparedness plans, flood control work and floodplain management regulations such as zoning ordinances, subdivision regulations, building codes and floodplain ordinances.

Floodproofing – Any combination of structural and nonstructural additions, changes or adjustments to properties and structures which reduce or eliminate flood damage to lands,

water, and sanitary facilities, structures, and contents of buildings. May include structural elevation, relocation, acquisition, or other floodproofing measures.

Floodwall – Flood barrier constructed of manmade materials, such as concrete or masonry designed to keep water away from a structure.

Flood Warning – A warning term that means flooding is already occurring or will occur soon in your area.

Flood Watch – A warning term that means that a flood is possible in your area.

Floodway – The channel of a river or other watercourse and the adjacent land areas required to carry and discharge the base flood without cumulatively increasing the water-surface elevation more than one foot at any point.

Floodway Fringe – The area between the floodway and the 100-year floodplain boundaries.

Freeboard – An additional amount of height usually expressed in feet above the Base Flood Elevation used as a factor of safety in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with State or community floodplain management regulations.

Freezing Rain – rain that freezes when it hits the ground, creating a coating of ice on roads, walkways, trees, and power lines.

Frost/Freeze Warning – below freezing temperatures are expected.

Fujita Scale – Rates tornadoes with number value from F0 to F5 based on wind speed and damage sustained.

Geographic Information System (GIS) - A computerized mapping and analysis tool. GIS can be a useful tool in mapping at-risk structures and infrastructure in the floodplain.

Greenways – Greenways are linear parks or corridors of open space that may extend across many communities. They can provide walking and biking links between parks, businesses, and culturally important sites. They embody a strategy for keeping riverside areas largely undeveloped, which provide recreational, cultural and aesthetic resources. Greenways can help to protect stretches of floodplain ecosystems.

Hail – hail or hailstones are irregular pellets or balls of ice falling from a cumulonimbus clouds.

Hazard – A source of potential danger or adverse condition. Hazards include naturally occurring events such as floods, earthquakes, tornadoes, tsunami, coastal storms, landslides, and wildfires that strike populated areas. A natural event is a hazard when it has the potential to harm people or property.

Hazard Mitigation – A plan to alleviate or make less severe the effects of a major disaster. Hazard mitigation can reduce the severity of the effects of a flood on people and property by reducing the cause or occurrence of the hazard and reducing exposure to the hazard.

Hazard Mitigation Grant Program (HMGP) – Authorized under Section 404 of the Stafford Act; provides funding for cost-effective hazard mitigation projects in conformance with the post-disaster mitigation plan.

Hazard Mitigation Plan – A plan resulting from a systematic evaluation of the nature and extent of vulnerability to the effects of natural hazards present in a community that includes the actions needed to minimize future vulnerability to hazards.

HAZUS – A GIS-based nationally standardized loss estimation tool developed by FEMA.

Headwater – Highest reaches of a stream in a drainage basin.

Hurricane – A severe tropical disturbance in the North Atlantic Ocean, Caribbean Sea, or Gulf of Mexico that achieves a sustained wind force of at least 74 miles per hour.

Hydrology – The science of the behavior of water in the atmosphere, on the earth's surface, and underground.

Hydrostatic Pressure – Forces imposed on an object, such as a structure, by standing water.

Increased Cost of Compliance (ICC) – Coverage under a standard NFIP flood insurance policy. ICC helps pay for the cost of mitigation, including demolition and relocation, up to $15,000 for a flood-insured structure that sustains a flood loss and is declared to be substantially or repetitively damaged.

Infrastructure – Public services that have a direct impact on the quality of life such public water supplies and sewer treatment facilities, and transportation networks such as airports, roads and railways.

Integrated Flood Observing and Warning System (IFLOWS) - A flood warning system developed by the National Weather Service that combines sensors, communication, and computer technology with advanced forecasting to provide timely guidance and advice to local emergency services staff.

Karst – A land area with topographic depressions such as sinkholes, springs, sinking streams and caves caused by underground solution of limestone bedrock.

Landslide - downward movement of a slope and materials under the force of gravity.

Levee – A man-made flood barrier constructed of compacted soil designed to contain, control, or divert the flow of water.

Lighting- lightning is an electrical circuit that is generated in cumulonimbus clouds (thunderheads) which have a negative electrical charge at the base and a positive charge at the top.

Lowest Floor – Under the NFIP program, the lowest floor of the lowest enclosed area, including a basement. An unfinished or flood-resistant enclosure such as a garage or storage area is not considered a building's lowest floor.

Magnitude – measurement of the energy released in an earthquake measured on the Richter Scale.

Mitigation – Sustained action that reduces or eliminates long term risk to people and property from natural hazards and their effects.

Mudflows – Sometimes called debris flows; mudflows are rivers of rock, earth, and debris saturated with water. They develop when water accumulates rapidly in the ground, so that earth becomes a flowing river of mud (called a slurry).

National Flood Insurance Program (NFIP) – Provides the availability of flood insurance in exchange for the adoption and enforcement of a minimum local floodplain management ordinance. The ordinance regulates new and substantially damaged or improved development in identified flood hazard areas. The Federal Emergency Management Agency administers this program.

Open Space – An area of land that is free of development, i.e. houses and other buildings that alter the area's natural appearance and impede the area's ability to covey flood flows. Open space can be used for parks, ball fields, hiking trails, garden spaces and other compatible open space uses.

Palmer Drought Severity Index (PDSI) – a measurement index which tracks moisture conditions and severity of drought conditions ranging from -4.0 (extremely dry) to +4.0 (excessively wet), with the mid-range (-2.0 to +2.0) representing the normal or near normal conditions.

Pre-FIRM/Post-FIRM – Pre-FIRM means that a building was constructed before the date of the initial Flood Insurance Rate Map (FIRM) issued to the community or before December 31, 1974, whichever is later. Post-FIRM means the building was constructed on or after the date of community initial FIRM, or after December 31, 1974, whichever is later.

Preparedness – Activities to ensure that people are ready for a disaster and respond to it effectively. Preparedness requires figuring out what will be done if essential services break down, developing a plan for contingencies, and practicing the plan.

Project Impact – A new project introduced by FEMA as a result of the increasing number and severity of disasters over the last decade to reduce the damage of disasters. It helps communities protect themselves from the effects of natural disasters by taking actions to reduce disruption and loss.

Rain Gardens – A water quality practice in which plants and soils are used to remove pollutants from stormwater. Also known as bio-retention.

Recovery – Activities necessary to rebuild after a disaster. Recovery activities include rebuilding homes, businesses and public facilitates; clearing debris; repairing roads and bridges; and restoring water, sewer and other essential services.

Recurrence Interval – The time between hazard events of similar size in a given location. It is based on the probability that the given event will be equaled or exceeded in any give year.

Relocation – The process of moving a house or other building to a new location outside the flood hazard area.

Repetitive Loss – An insured structure that has sustained flood damage on more than one occasion with claims of at least $1,000 each within any 10-year period since 1978.

Response – Activities to address the immediate and short-term effects of an emergency or disaster. Response activities include immediate actions to save lives, protect property, and meet basic human needs.

Retrofitting – Making changes to an existing house or other building to protect it from flooding or other hazards.

Richter Scale – a numerical scale of earthquake magnitude devised by seismologist C. F. Richter in 1935.

Riparian System – Ecosystem occurring in the interface between aquatic and terrestrial systems, in floodplains and adjacent to rivers and streams. Riparian systems are subject to direct influences of ground and or surface waters, and occasional flooding.

Riprap – Broken stone, cut stone blocks, or rubble that is placed on slopes to protect them from erosion or scouring caused by floodwaters.

Riverine – Relating to, formed by, or resembling a river, including tributaries, streams, brooks, etc. Riverine flooding occurs when a river or stream overflows its banks and causes considerable inundation of nearby land and roads.

Seismic – describes activity related to earthquakes.

Seismic waves – vibrations that travel outward for the center of the earthquake at speeds of several miles per second.

Severe Thunderstorm Watch – a sever thunderstorm is expected in the next six hours within an area approximately 120 to 150 miles wide and 300 to 400 miles wide.

Severe Thunderstorm Warning – indicates a severe thunderstorm is occurring or is imminent in about 30 minutes to 1 hour.

Sink Holes – Natural depressions in the landscape caused by solution and subsidence of earth materials.

Sleet – rain that turns to ice pellets before reaching the ground. Sleet also causes roads to freeze and become slippery.

Special Flood Hazard Area (SFHA) - The shaded area on a FIRM map that identifies an area that has 1% chance of being flooding in any given year (100-year floodplain).

Stafford Act – Robert T. Stafford Disaster Relief and Emergency Assistance Act, PL 100-707, signed into law November 23, 1988; amended the Disaster Relief Act of 1974, PL 93-288. The statutory authority for most Federal disaster response activities especially as they pertain to FEMA and FEMA programs.

Stormwater – Water from precipitation that flows across the ground and pavement when it rains, floods, or when snow and ice melt. The water seeps into the ground or drains into what we call storm sewers.

Substantial Damage – Damage of any origin sustained by a structure whereby the cost of restoring the structure to its pre-damaged condition would equal or exceed 50 percent of the market value of the structure before the damage occurred.

Topography – The elevations of the land surface.

Tornado – a violently rotating column of air extend form thunderstorm to the ground.

Tornado Warning – a tornado has been sighted or indicated by weather radar. Take shelter immediately.

Tornado Watch – Tornadoes are possible.

Tropical Storm – A tropical cyclone with maximum sustained winds greater than 39 mph and less than 74 mph.

Urban-Wildland Interface Zone – the developed area that occupies the boundary between an urban or settled are and the undeveloped natural forest environment.

Vulnerability – A term used to describe how exposed or susceptible to damage an asset is. Vulnerability depends on an asset's construction, contents and the economic value of its function.

Watershed – The area of land that is drained by a river and its tributaries. Ridges or divides separate watersheds from each other.

Waterspout – a tornado that forms over water.

Wet Floodproofing – Protecting a building by allowing flood waters to enter so that internal and external hydrostatic pressure is equalized. Usually enclosed areas used for parking, storage, or building access are wet floodproofed.

Wetlands – Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

Wildfire - an uncontrollable fire spreading through vegetative fuels, exposing and possibly consuming structures.

Wildland Fire – a fire in which development is essentially nonexistent, except for roads, railroads, power lines and similar facilities.

Winter Storm Watch – a winter storm is possible in your area.

Winter Storm Warning – a winter storm is occurring, or will soon occur in your area.

2 - Hazard Identification

Types of Hazards

While nearly all disasters are possible for any given area in the United States, the most likely hazards that could potentially affect the communities in the Central Shenandoah Planning District generally include:

- Droughts
- Flooding
- Hurricanes
- Karst Topography
- Terrorism
- Tornadoes
- Landslides
- Land Subsidence
- Wildfires
- Winter Storms

Probability of Hazards

Hazards were ranked by the steering committee to determine what hazards they evaluated to have the largest impact on their communities. The results are summarized in Table 2. Certain hazards were not addressed as a result of the infrequency of occurrence and/or limited impact. Earthquake, for example, falls into this category. Analysis level was determined by the type of data available and the scale of data available for the analysis.

Table 2
Central Shenandoah PDC Planning Consideration Levels

Hazard Identification Results	
Hazard Type	**Rank**
Flooding	Significant
Drought	High
Hurricane	High
Severe Winter Weather	High
Land Subsidence/Karst	Medium
Tornado	Medium
Wildfire	Medium
Landslide	Low
Terrorism	Low
Earthquake	None

Major Disasters

Table 3 lists the major disasters that have occurred in the Planning District including Presidentially declared disasters. Since 1969, the CSPDC has had 85 declared disasters. Refer to the perspective county for town totals. When town specific information was available, it is included in the description portion of table 4. Table 4 shows the types of hazards and event descriptions that have impacted the communities in CSPDC.

Table 3
Central Shenandoah PDC Federal Disasters
Summary by Community (last updated 5/24/2004).

Communities	Declared Disasters
Augusta County	12
Bath County	11
Buena Vista City	11
Harrisonburg City	6
Highland County	8
Lexington City	6
Rockbridge County	12
Rockingham County	9
Staunton City	4
Waynesboro City	6
Total	**85**

Table 4
Central Shenandoah PDC Federal Disasters

Community	Date of Declaration	DR#	VDEM/Federal Description
Augusta, Bath & Rockbridge	August 23, 1969 Hurricane Camille	274	This major storm made landfall out of the Gulf as a category 5 and weakened to a tropical depression before reaching the state. Precipitation rained over regions many hours, dropping more than 27 inches of rain in Nelson County and over ten inches in the area from Lynchburg to Charlottesville. Flooding and landslides, triggered by saturated soils, resulted in catastrophic damage. More than 150 people died and another 100 were injured. At the time, damage was estimated at more than $113 million. In the Central Shenandoah Region, as a result of Camille, significant flooding occurred in Rockbridge County, the Cities of Buena Vista and Waynesboro, and the Town of Glasgow. Twenty-three people died in Rockbridge County, with damages exceeding 30 million dollars (1969 dollars).

Community	Date of Declaration	DR#	VDEM/Federal Description
Bath, Buena Vista, Harrisonburg, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	June 23, 1972 Hurricane Agnes	339	This event produced devastating flooding throughout the Mid-Atlantic States. Some areas of eastern Virginia received over 15 inches of rainfall as the storm moved through. The Potomac and James Rivers experienced major flooding, which created 5 to 8 feet flood waters in many locations along the rivers. Richmond was impacted the most by these high water levels. Water supply and sewage treatment plants were inundated, as were electric and gas plants. Only one of the five bridges across the James River was open, while the Downtown area was closed for several days and businesses and industries in the area suffered immense damage. Sixteen people lost their lives in the state and damage was estimated at $222 million. These startling numbers resulted in 63 counties and 23 cities qualifying for disaster relief. In the Central Shenandoah region, the City of Waynesboro was hardest hit. Damage estimates at the time reached hundreds of thousands of dollars. In Rockbridge County, the City of Buena Vista and the Town of Glasgow received funding for the disaster.
Buena Vista	October 7, 1972	358	Severe Storms & Flooding
Augusta, Buena Vista, Rockbridge, Rockingham	October 10, 1972	359	Severe Storms & Flooding
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Waynesboro	November 9, 1985 Hurricane Juan	755	Heavy rainfall from October 31 through November 6, 1985, caused record-breaking floods over a large region, including western and northern Virginia. Most of the rain fell on November 4 and 5 causing flash flooding. Heavy rainfall was indirectly related to Hurricane Juan. The Roanoke River rose seven feet in one hour and 18 feet in six hours, cresting at 23 feet on November 5 .There were 22 deaths in Virginia as a result of the flooding. FEMA declared 50 jurisdictions disaster areas, 1.7 million people were affected by the flooding. Flooding damages were estimated at $800 million. Areas all across the Central Shenandoah region were affected by the flooding caused by Hurricane Juan. Homes, businesses, bridges, and roads were damaged. The City of Waynesboro had significant damage when the South River broke previous flood records, damaging 140 homes, 32 mobile homes, and 41 businesses.
Augusta, Bath, Buena Vista, Lexington, Rockbridge, Rockingham	May 19, 1992	944	Severe Storms & Flooding
Bath, Buena Vista, Rockbridge	March 10, 1994	1014	Severe Ice Storms, Flooding

Community	Date of Declaration	DR#	VDEM/Federal Description
Augusta, Highland	April 11, 1994	1021	This winter storm coated portions of Virginia with 1 to 3 inches of ice from freezing rain and sleet. This led to the loss of approximately 10 to 20 percent trees in some counties, which blocked roads and caused many people to be without power for a week. There were numerous automobile accidents and injuries from people falling on ice. Damages were estimates at $61 million.
Augusta, Bath, Buena Vista, Lexington, Rockbridge, Staunton	July 1, 1995	1059	Severe Storms & Flooding In the Central Shenandoah region, a week-long period of ground saturating rains fell. Rain caused flash flooding in Augusta and Rockbridge Counties. In the Town of Glasgow, interior mountain streams, instead of the James and Maury rivers, caused the flooding in the first floors of 42 homes and the basements and crawl spaces of 64 homes.
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	January 13, 1996	1086	Also known as the "Great Furlough Storm" due to Congressional impasse over the federal budget, the blizzard paralyzed the Interstate 95 corridor, and reached westward into the Appalachians where snow depths of over 48 inches were recorded. Several local governments and schools were closed for more than a week. The blizzard was followed with another storm, which blanketed the entire state with at least one foot of snow. To compound things, heavy snowfall piled on top of this storm's accumulations in the next week, which kept snow pack on the ground for an extended period of time. This snow was eventually thawed by higher temperatures and heavy rain that fell after this thaw resulted in severe flooding. Total damage between the blizzard and subsequent flooding was over $30 million.
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham, Waynesboro	January 27, 1996	1098	Flooding -- Snow Melt
Augusta, Bath, Buena Vista, Harrisonburg, Highland, Lexington, Rockbridge, Rockingham, Staunton, Waynesboro	September 6, 1996 Hurricane Fran	1135	This hurricane is notable not only for the $350 million in damages, but because of its widespread effects, including a record number of people without power and the closure of 78 primary and 853 secondary roads. Rainfall amounts between 8 and 20 inches fell over the mountains and Shenandoah Valley, leading to record-level flooding in many locations within this region. 100 people had to be rescued from the flood waters and hundreds of homes and buildings were damaged by the flood waters and high winds. In the Central Shenandoah region, Rockingham County was the hardest hit when the Shenandoah River and its tributaries broke previous records of flooding. The Naked Creek area in Rockingham was particularly hit. In Rockingham County, 16 homes and 18 mobile homes were completely destroyed and 334 structures incurred damages.

Community	Date of Declaration	DR#	VDEM/Federal Description
Augusta, Bath, Highland, Rockbridge, Rockingham	February 28, 2000	1318	Winter Storms
Bath	July 2, 2001	1386	A total of six federal disasters, primarily flooding and severe storms, have been declared in Southwest Virginia from 2001-2004 (Disasters 1386, 1406, 1411, 1458, 1502, and 1525). The worse hit counties were Tazewell (all 6 disasters), Buchanan (5 disasters), and Russell (4 disasters). Dickenson, Lee, Smyth, and Wise Counties were also declared in half of these six disasters. Many of these disasters have storm tracks along the mountain valleys, producing excessive localized flooding. Catastrophic flooding has been experienced in rural settlements as well as in Bluefield, Hurley, Appalachia, Pennington Gap, Norton, Dante and Wise.
Highland	April 1, 2003	1458	2004 NOVA Snowstorm & SW VA Floods
Augusta, Buena Vista, Harrisonburg, Highland, Rockbridge, Rockingham, Staunton, Waynesboro	September 18, 2003 Hurricane Isabel	1491	Hurricane Isabel entered Virginia September 18 after making landfall along the North Carolina Outer Banks. The Commonwealth sustained tropical storm winds for 29 hours with some maximum winds approaching 100 mph. The hurricane produced storm surge of 5 to 8 feet along the coast and in the Chesapeake Bay with rainfall totals between 2 to 11 inches along its track. Twenty-one inches of rainfall was measured near Waynesboro Virginia. Damages due to wind, rain, and storm surge resulted in flooding, electrical outages, debris, transportation interruption, and damaged homes and businesses. At the height of the incident approximately 6,000 residents were housed in 134 shelters and curfews were imposed in many jurisdictions. Further damages occurred when a series of thunderstorms and tornados came through many of the designated areas in the southeast portion of Virginia on September 23. There were a total of 36 confirmed deaths. More than 93,000 registrations were made for assistance. Residential destruction included 1,186 homes reported destroyed and 9,110 with major damage, 107,908 minor damage, with losses estimated over $590 million. Of the 1,470 businesses involved, 77 are reported destroyed, 333 suffered major damage and 1,060 businesses suffered minor or casual damage, with losses exceeding $84 million. Public assistance exceeds $250 million and continues to increase. More than two-thirds of the households and businesses within the Commonwealth were without power. Remote locations did not have power restored for three weeks. In the Central Shenandoah region, Augusta County received the most rainfall, 20.6 inches, and Rockbridge County received the most damages. Rockbridge County received extensive damage along the South River along Route 608. More than a dozen homes and three bridges were completely destroyed. Rockbridge County had extensive property damages.

Level of Hazard

Table 5 provides a breakdown of the natural hazards addressed in this plan. The level of planning consideration given to each hazard was determined by the committee members. Based on the input of committee members, the hazards were broken into four distinct categories which represent the level of consideration they will receive throughout the planning process.

In order to focus on the most critical hazards that may affect the communities of the planning district, the hazards assigned a level of *Significant*, *High* and *Medium* will receive the most extensive attention in the remainder of the planning analysis, while those with a *Low* planning consideration level will be assessed in more general terms. Those hazards with a planning level of *None* will not be addressed in this plan. The level of *None* should be interpreted as not being critical enough to warrant further evaluation; however, these hazards should not be interpreted as having zero probability or impact.

As can be seen in Table 2, earthquakes have been designated with a hazard level of *None*, and will not be included in this analysis. An earthquake is the shaking of the ground's surface caused by movements of the plates beneath it. Though there have been historical occurrences of earthquakes that have affected the area, the probability and impact is low enough for the overall risk to be considered "none" at a planning level. This reasoning is supported by a loss estimate created using FEMA's HAZUS-MH that shows annualized losses for the region as about $654,000. This number is compared to annualized losses from wind events at $1.03 million.

Table 5
Central Shenandoah PDC Natural Hazards HIRA Overview

Hazard	Type	Detail Level	Analysis Level	Data Reference
Flooding	Riverine	Significant	Covered by HIRA flood analysis	FEMA DFIRM, Q3, and FIRM Mapping
Drought	Including excessive heat	High	Covered by HIRA drought analysis	Drought Monitor Task Force, Water Systems
Wind	Hurricane	High	Covered by HIRA hurricane analysis	FEMA DFIRM, Q3, and FIRM Mapping and ASCE Design Wind Speed Maps, FEMA HAZUS-MH model
Severe Winter Weather	Including winter storms, ice storms, and excessive cold	High	Covered by HIRA blizzards/winter storm analysis	NOAA National Weather Service Records, VirginiaView PRISM, Climate Source
Karst/Land Subsidence	Karst/Land Subsidence	Medium	Covered by HIRA karst analysis	USGS, VT Mines & Minerals
Wind	Tornado	Medium	Description and Regional Maps	NOAA National Weather Service Records
Wildfire	Wildfire	Medium	Covered by HIRA wildfire analysis	Virginia Department of Forestry
Landslide	Landslide	Low	Description and Regional Maps	USGS
Terrorism	Terrorism	Low	Description	Addressed in community Emergency Operation Plans (EOP)
Earthquake	Earthquake	None	None, due to infrequency of occurrence	FEMA HAZUS-MH

3 - Flooding (Significant Ranking)

Hazard History

Listed below are major flooding events that have occurred in the Central Shenandoah PDC. In Table 4 and Appendix A, some major events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire planning area.

- Flood of September 1870
- Flood of September 1896
- Flood of August 1906
- Flood of March 1936
- Flood of June 1949
- Flood of September 1950
- Hurricane Camille - August 1969
- Hurricane Agnes - June 1972
- Hurricane Juan - November 1985
- Summer Floods of June - June 1995
- Snowmelt Flood of January - January 1996
- Hurricane Fran - September 1996
- Hurricane Isabel – September 2003

Hazard Profile

A flood is a natural event for rivers and streams. Excess water from snowmelt, rainfall, or storm surge accumulates and overflows onto the banks and adjacent floodplains. Floodplains are lowlands, adjacent to rivers, lakes and oceans that are subject to recurring floods. Under natural conditions, a flood causes little or no damage. Flood problems only exist when the built environment is damaged by nature's water or when property and lives are jeopardized. Floods in our area are almost always associated with hurricanes, tropical storms and tropical depressions. However, some of our flooding is caused by sustained heavy rains, thunderstorms and even rapid snowmelts.

While the Central Shenandoah Valley experiences nearly all types of natural disasters, including winter snow and ice storms, wild fires, and tornadoes, flooding is perhaps the most common and devastating type of disaster. It is also the most common hazard in the United States with hundreds of floods occurring every year causing an average of 150 deaths annually. In the past 35 years, the Central Shenandoah Valley Region has received 14 federal disaster declarations, nine due to flooding. Floods in 1969, 1972, 1985, 1992, 1994, 1995, two in 1996, 1998 and 2003 have had severe and long-term effects on property owners, local businesses, industry and our economy.

Floods typically are characterized by frequency, for example the "1%-annual chance flood," commonly referred to as the "100-year" flood. While more frequent floods do occur, as

well as larger events that have lower probabilities of occurrence, for most regulatory and hazard identification purposes, the 1%-percent annual chance flood is used. Homes and business may suffer damage and be susceptible to collapse. Floods pick up chemicals, sewage and toxins from roads, factories and farms, therefore any property affected by the flood may be contaminated with hazardous materials. Debris from vegetation and man-made structures may also be hazardous following the occurrence of a flood. In addition, floods may threaten water supplies and water quality, as well as initiate power outages.

Secondary Effects

Flooding can pose some significant secondary impacts to the area where the event has taken place. Some of the impacts to consider include infrastructure and utility failure, impacts to roadways, water service and wastewater treatment. These impacts can affect the entire planning district, making the area vulnerable to limited emergency services.

Flood Maps

More detailed data was available as "Q3 flood maps" for a majority of the counties in the region. The Q3 flood maps are digital versions of the FEMA paper FIRMs that have been georectified and digitized. When a digital version of the floodplains was not available, digital paper copies of the FEMA Flood Insurance Rate Maps (FIRMs) were utilized. To be able to conduct analysis, the digital paper FIRMs were georectified and digitized. Figure 4 denotes the extent of FEMA mapped floodplains in the region.

Vulnerability Analysis

Specific areas that are susceptible to flooding were determined by Central Shenandoah PDC when developing the Central Shenandoah Valley Regional Flood Mitigation Plan (FMA). See Appendix B for the jurisdictional flood maps; these maps provide detailed information on areas susceptible to flooding. These areas were taken into account when completing the hazard identification and risk assessment.

Many factors contribute to the relative vulnerabilities of areas within the floodplain. Some of these factors include development or the presence of people and property in the floodplain, flood depth, velocity, elevation, construction type and flood duration.

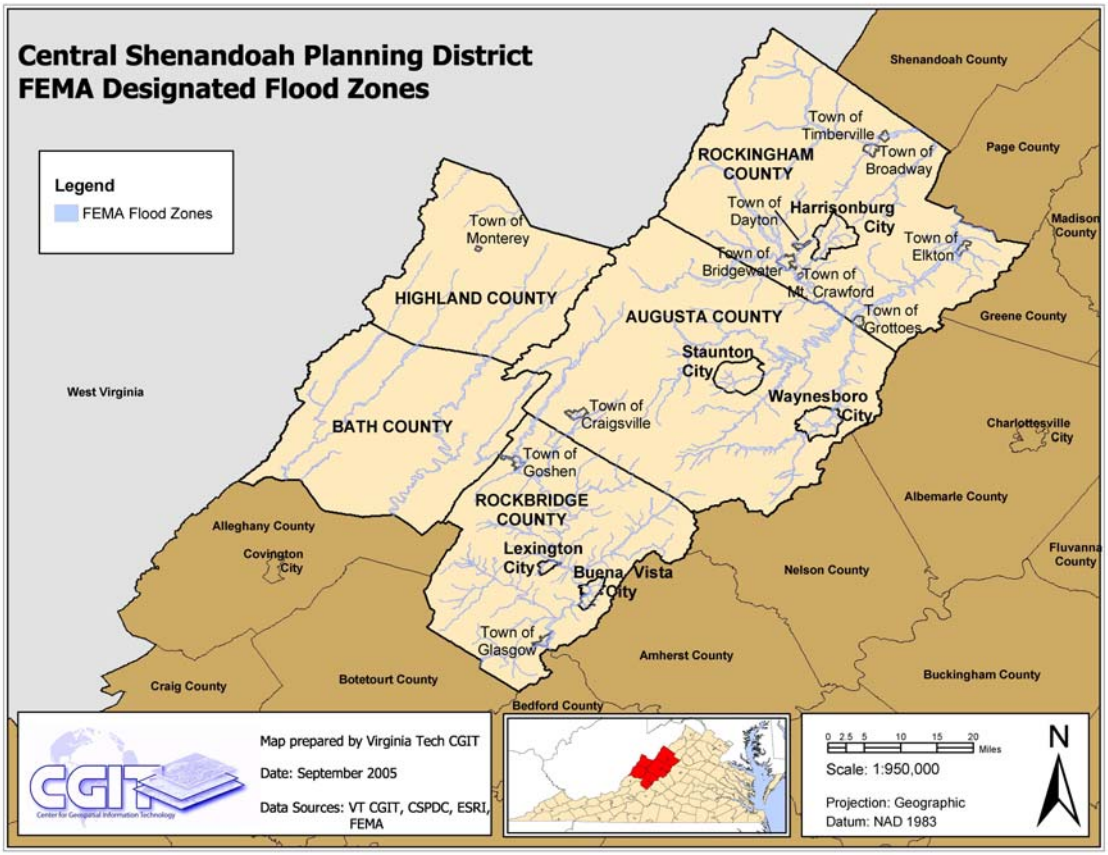

Figure 4 - Central Shenandoah PDC Floodplains.

FEMA-Designated Repetitive Loss Properties

FEMA provides a Repetitive Loss List of the properties in a community that have received two or more flood insurance claims, greater than $1,000, from the National Flood Insurance Program (NFIP) within a 10 year timeframe. The Repetitive Loss list includes pertinent information regarding the property address, dates of claims, amounts received and owner information. Some of this information has been withheld from Table 6; see your local NFIP coordinator for specific information.

There are 163 repetitive loss properties in the CSPDC, with an average payment of $25,179 per structure (Table 6). A majority (65%) of the repetitive loss structures for the Central Shenandoah region are single family homes. The Cities of Waynesboro and Buena Vista account for approximately 55% of the repetitive loss properties in the region. Note that FEMA designates counties, cities and towns separately in the table.

Table 6
CSPDC Repetitive Loss Structures (from FEMA).

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
AUGUSTA COUNTY	YES	2-4 FAMILY	A	$52,447	$36,687	$10,000	3	$46,687	$15,562
AUGUSTA COUNTY	NO	SINGLE FMLY	A	$35,000	$16,168	$0	2	$16,168	$8,084
AUGUSTA COUNTY	YES	SINGLE FMLY	AE	$139,118	$33,323	$0	2	$33,323	$16,661
AUGUSTA COUNTY	NO	NON RESIDNT	A	$42,200	$18,021	$0	2	$18,021	$9,011
AUGUSTA COUNTY	YES	NON RESIDNT	A	$75,000	$30,121	$8,374	2	$38,496	$19,248
AUGUSTA COUNTY	YES	SINGLE FMLY	X	$58,000	$10,597	$0	2	$10,597	$5,298
AUGUSTA COUNTY	YES	SINGLE FMLY	A	$5,328,400	$22,732	$7,397	2	$30,129	$15,065
AUGUSTA COUNTY	YES	NON RESIDNT	A	$180,000	$137,837	$0	4	$137,837	$34,459
AUGUSTA COUNTY	NO	SINGLE FMLY	EMG	$25,000	$1,217	$2,855	2	$4,072	$2,036
BATH COUNTY	NO	SINGLE FMLY	A	$23,660	$22,771	$2,176	2	$24,947	$12,474
BATH COUNTY	YES	SINGLE FMLY	A	$34,450	$23,195	$8,809	3	$32,004	$10,668
BRIDGEWATER, TOWN OF	NO	SINGLE FMLY	A18	$111,200	$8,179	$4,400	2	$12,579	$6,289
BRIDGEWATER, TOWN OF	NO	SINGLE FMLY	A18	$36,000	$14,349	$3,337	2	$17,686	$8,843
BROADWAY, TOWN OF	YES	SINGLE FMLY	X	$105,073	$19,409	$2,669	3	$22,079	$7,360
BROADWAY, TOWN OF	NO	NON RESIDNT	C	$442,463	$40,045	$0	2	$40,045	$20,023
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$30,800	$10,890	$32,005	2	$42,895	$21,448
BUENA VISTA, CITY OF	YES	SINGLE FMLY	A11	$53,500	$34,936	$28,145	3	$63,081	$21,027
BUENA VISTA, CITY OF	YES	SINGLE FMLY	B	$40,000	$48,355	$26,502	4	$74,857	$18,714
BUENA VISTA, CITY OF	YES	SINGLE FMLY	B	$44,000	$12,559	$3,541	2	$16,100	$8,050
BUENA VISTA, CITY OF	NO	SINGLE FMLY	B	$43,500	$19,165	$4,063	2	$23,228	$11,614
BUENA VISTA, CITY OF	YES	SINGLE FMLY	B	$172,700	$21,406	$4,166	3	$25,572	$8,524

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$285,600	$5,526	$28,097	3	$33,622	$11,207
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$1,754,168	$40,417	$32,223	4	$72,640	$18,160
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$50,000	$39,037	$55,838	4	$94,875	$23,719
BUENA VISTA, CITY OF	NO	NON RESIDNT	B	$60,000	$0	$5,535	2	$5,535	$2,767
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$74,700	$14,649	$3,405	2	$18,054	$9,027
BUENA VISTA, CITY OF	YES	SINGLE FMLY	A11	$51,000	$22,562	$5,403	3	$27,966	$9,322
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A	$19,900	$14,939	$0	3	$14,939	$4,980
BUENA VISTA, CITY OF	NO	SINGLE FMLY	B	$47,000	$23,639	$5,132	3	$28,771	$9,590
BUENA VISTA, CITY OF	YES	SINGLE FMLY	A11	$60,700	$3,986	$950	2	$4,936	$2,468
BUENA VISTA, CITY OF	YES	SINGLE FMLY	B	$48,102	$18,589	$9,211	3	$27,800	$9,267
BUENA VISTA, CITY OF	NO	SINGLE FMLY	B	$83,200	$47,186	$9,580	2	$56,766	$28,383
BUENA VISTA, CITY OF	YES	SINGLE FMLY	B	$42,600	$18,742	$5,600	2	$24,342	$12,171
BUENA VISTA, CITY OF	NO	NON RESIDNT	B	$70,000	$3,482	$377	2	$3,858	$1,929
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$15,000	$0	$19,458	2	$19,458	$9,729
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$497,200	$49,072	$630	2	$49,702	$24,851
BUENA VISTA, CITY OF	YES	NON RESIDNT	A11	$200,000	$14,615	$0	2	$14,615	$7,308
BUENA VISTA, CITY OF	YES	NON RESIDNT	A11	$64,000	$7,056	$0	2	$7,056	$3,528
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$549,900	$2,067	$204	2	$2,271	$1,135
BUENA VISTA, CITY OF	YES	ASSMD CONDO	A11	ASSUMED CONDO	$212,544	$607,231	5	$819,774	$163,955
BUENA VISTA, CITY OF	YES	NON RESIDNT	A11	$66,480	$6,605	$23,475	2	$30,080	$15,040
BUENA VISTA, CITY OF	YES	NON RESIDNT	A11	$200,000	$11,306	$0	2	$11,306	$5,653
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$50,000	$70,283	$192,016	5	$262,298	$52,460
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$1,497,600	$41,380	$8,276	4	$49,655	$12,414
BUENA VISTA, CITY OF	NO	NON RESIDNT	A11	$225,000	$184	$3,328	2	$3,512	$1,756
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A	$24,000	$15,319	$0	2	$15,319	$7,659
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$37,700	$21,123	$3,400	3	$24,523	$8,174
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A	$12,900	$30,199	$1,803	4	$32,002	$8,000

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$80,900	$74,441	$17,359	4	$91,800	$22,950
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$97,200	$39,272	$0	4	$39,272	$9,818
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$96,700	$32,155	$8,515	3	$40,670	$13,557
BUENA VISTA, CITY OF	NO	SINGLE FMLY	B	$60,500	$10,225	$0	2	$10,225	$5,112
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$45,600	$14,000	$19,681	2	$33,681	$16,840
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$53,000	$63,628	$18,713	4	$82,341	$20,585
BUENA VISTA, CITY OF	NO	SINGLE FMLY	A11	$67,700	$26,920	$0	3	$26,920	$8,973
ELKTON, TOWN OF	NO	SINGLE FMLY	A	$65,800	$20,804	$0	2	$20,804	$10,402
GLASGOW, TOWN OF	NO	SINGLE FMLY	C	$93,439	$26,943	$10,425	2	$37,368	$18,684
GLASGOW, TOWN OF	NO	ASSMD CONDO	A12	ASSUMED CONDO	$40,600	$23,504	2	$64,104	$32,052
GLASGOW, TOWN OF	NO	SINGLE FMLY	C	$35,452	$20,803	$13,971	2	$34,773	$17,387
GLASGOW, TOWN OF	NO	ASSMD CONDO	A16	ASSUMED CONDO	$48,109	$10,000	3	$58,109	$19,370
GLASGOW, TOWN OF	NO	SINGLE FMLY	A12	$71,100	$32,559	$31,933	3	$64,492	$21,497
GLASGOW, TOWN OF	NO	SINGLE FMLY	A16	$66,500	$36,660	$11,012	2	$47,672	$23,836
GLASGOW, TOWN OF	YES	SINGLE FMLY	A12	$65,000	$105,676	$24,100	2	$129,776	$64,888
GLASGOW, TOWN OF	NO	SINGLE FMLY	A12	$41,710	$24,226	$8,584	2	$32,810	$16,405
GLASGOW, TOWN OF	NO	NON RESIDNT	C	$216,000	$72,365	$118,692	3	$191,057	$63,686
GLASGOW, TOWN OF	NO	NON RESIDNT	C	$70,800	$26,357	$0	2	$26,357	$13,179
GLASGOW, TOWN OF	NO	NON RESIDNT	B	$64,200	$6,464	$5,410	2	$11,874	$5,937
GOSHEN, TOWN OF	YES	SINGLE FMLY	B	$44,811	$25,864	$0	2	$25,864	$12,932
GOSHEN, TOWN OF	YES	NON RESIDNT	B	$4,720,000	$215,543	$599,595	5	$815,138	$163,028
GOSHEN, TOWN OF	NO	SINGLE FMLY	A04	$125,000	$5,312	$2,890	2	$8,202	$4,101
HARRISONBURG, CITY OF	YES	SINGLE FMLY	X	$115,000	$11,608	$0	2	$11,608	$5,804
LEXINGTON, CITY OF	NO	2-4 FAMILY	A13	$75,000	$118,693	$0	4	$118,693	$29,673
LEXINGTON, CITY OF	NO	2-4 FAMILY	A13	$83,900	$86,415	$0	5	$86,415	$17,283
LEXINGTON, CITY OF	NO	2-4 FAMILY	A	$150,000	$157,703	$0	4	$157,703	$39,426
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$2,750,000	$10,035	$0	2	$10,035	$5,017

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
ROCKBRIDGE COUNTY	NO	2-4 FAMILY	A	$248,531	$76,812	$3,154	2	$79,966	$39,983
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	AE	$54,880	$29,192	$10,760	2	$39,951	$19,976
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	A	$72,718	$30,801	$12,000	2	$42,801	$21,400
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$72,500	$37,215	$11,000	2	$48,215	$24,107
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$57,000	$34,156	$0	2	$34,156	$17,078
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	B	$43,293	$18,418	$9,541	3	$27,959	$9,320
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A04	$80,120	$47,862	$16,210	4	$64,072	$16,018
ROCKBRIDGE COUNTY	NO	NON RESIDNT	AE	$183,150	$19,866	$21,362	2	$41,228	$20,614
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$153,810	$60,302	$4,624	3	$64,926	$21,642
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	C	$87,000	$16,497	$0	2	$16,497	$8,249
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	A06	$80,985	$174,146	$71,273	6	$245,419	$40,903
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	C	$42,840	$22,420	$2,587	3	$25,007	$8,336
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	A	$74,705	$14,896	$538	2	$15,434	$7,717
ROCKBRIDGE COUNTY	NO	2-4 FAMILY	A	$41,300	$172,282	$0	5	$172,282	$34,456
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$99,500	$24,458	$0	2	$24,458	$12,229
ROCKBRIDGE COUNTY	YES	ASSMD CONDO	A13	ASSUMED CONDO	$24,245	$27,351	3	$51,597	$17,199
ROCKBRIDGE COUNTY	NO	SINGLE FMLY	A	$54,120	$9,492	$5,421	2	$14,914	$7,457
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	A	$51,000	$5,343	$0	2	$5,343	$2,672
ROCKBRIDGE COUNTY	YES	SINGLE FMLY	A	$65,500	$34,861	$0	3	$34,861	$11,620
ROCKBRIDGE COUNTY	NO	2-4 FAMILY	A	$82,500	$160,046	$0	3	$160,046	$53,349
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A15	$106,400	$24,628	$0	2	$24,628	$12,314
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A19	$69,800	$31,505	$0	2	$31,505	$15,752
ROCKINGHAM COUNTY	NO	NON RESIDNT	A	$650,000	$400,000	$437,147	2	$837,147	$418,574
ROCKINGHAM COUNTY	NO	NON RESIDNT	A	VAL NOT AVAIL	$0	$59,197	3	$59,197	$19,732
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A	$59,400	$42,075	$0	2	$42,075	$21,038
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A15	$130,500	$54,860	$11,711	2	$66,571	$33,285
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A15	$87,200	$44,467	$12,560	2	$57,027	$28,513

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A	$35,635	$12,453	$3,830	2	$16,283	$8,142
ROCKINGHAM COUNTY	NO	SINGLE FMLY	AE	$53,370	$22,280	$8,017	2	$30,297	$15,148
ROCKINGHAM COUNTY	NO	SINGLE FMLY	AE	$105,800	$41,670	$14,452	3	$56,122	$18,707
ROCKINGHAM COUNTY	NO	SINGLE FMLY	C	$45,000	$13,907	$9,222	2	$23,130	$11,565
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A	$32,200	$19,924	$0	2	$19,924	$9,962
ROCKINGHAM COUNTY	NO	SINGLE FMLY	C	$32,127	$9,287	$991	2	$10,278	$5,139
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A15	$68,200	$49,701	$0	2	$49,701	$24,851
ROCKINGHAM COUNTY	YES	NON RESIDNT	C	$1,516,284	$104,346	$5,300	3	$109,646	$36,549
ROCKINGHAM COUNTY	YES	SINGLE FMLY	A04	$135,744	$54,543	$0	2	$54,543	$27,272
ROCKINGHAM COUNTY	NO	SINGLE FMLY	A15	$73,200	$47,491	$19,921	3	$67,412	$22,471
STAUNTON, CITY OF	YES	SINGLE FMLY	AE	$121,304	$6,253	$0	2	$6,253	$3,127
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$134,144	$23,072	$0	3	$23,072	$7,691
WAYNESBORO, CITY OF	YES	NON RESIDNT	B	$40,404	$0	$36,567	3	$36,567	$12,189
WAYNESBORO, CITY OF	YES	ASSMD CONDO	A08	ASSUMED CONDO	$18,422	$230,758	3	$249,180	$83,060
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$705,781	$49,140	$12,851	2	$61,992	$30,996
WAYNESBORO, CITY OF	NO	NON RESIDNT	A04	$154,600	$5,760	$195,221	2	$200,981	$100,490
WAYNESBORO, CITY OF	YES	NON RESIDNT	A08	$554,640	$45,200	$39,100	4	$84,300	$21,075
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$69,147	$17,509	$0	3	$17,509	$5,836
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$72,405	$7,087	$333	3	$7,420	$2,473
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$57,750	$15,690	$0	2	$15,690	$7,845
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$62,760	$13,114	$1,651	4	$14,765	$3,691
WAYNESBORO, CITY OF	NO	SINGLE FMLY	A08	$98,500	$4,490	$167	2	$4,657	$2,329
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$126,120	$152,196	$10,600	3	$162,796	$54,265
WAYNESBORO, CITY OF	NO	SINGLE FMLY	AE	$98,000	$102,733	$15,301	3	$118,034	$39,345
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$131,535	$106,787	$30,500	4	$137,287	$34,322
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$104,838	$97,481	$15,555	4	$113,036	$28,259
WAYNESBORO, CITY OF	NO	SINGLE FMLY	B	$124,542	$7,307	$0	2	$7,307	$3,653

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$81,000	$45,585	$11,000	3	$56,585	$18,862
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$107,704	$73,126	$32,412	4	$105,539	$26,385
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$125,000	$55,452	$11,885	4	$67,337	$16,834
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$116,637	$54,099	$28,367	3	$82,466	$27,489
WAYNESBORO, CITY OF	YES	SINGLE FMLY	C	$108,790	$10,038	$5,416	3	$15,455	$5,152
WAYNESBORO, CITY OF	YES	NON RESIDNT	B	$273,300	$19,785	$7,347	3	$27,132	$9,044
WAYNESBORO, CITY OF	NO	SINGLE FMLY	AE	$49,800	$12,417	$0	2	$12,417	$6,209
WAYNESBORO, CITY OF	NO	NON RESIDNT	B	$200,000	$90,198	$136,636	2	$226,834	$113,417
WAYNESBORO, CITY OF	YES	SINGLE FMLY	X	$99,900	$49,071	$11,653	3	$60,725	$20,242
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$599,400	$43,590	$177,777	4	$221,367	$55,342
WAYNESBORO, CITY OF	YES	NON RESIDNT	A08	$66,843	$53,886	$0	3	$53,886	$17,962
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$783,145	$100,231	$0	3	$100,231	$33,410
WAYNESBORO, CITY OF	NO	NON RESIDNT	AE	$494,000	$69,939	$173,000	3	$242,938	$80,979
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$671,499	$224,950	$50,956	2	$275,906	$137,953
WAYNESBORO, CITY OF	NO	NON RESIDNT	A08	$738,700	$34,497	$190,295	2	$224,792	$112,396
WAYNESBORO, CITY OF	YES	NON RESIDNT	A08	$135,600	$91,323	$0	3	$91,323	$30,441
WAYNESBORO, CITY OF	YES	NON RESIDNT	AE	$135,600	$33,967	$0	3	$33,967	$11,322
WAYNESBORO, CITY OF	YES	SINGLE FMLY	X	$69,278	$21,593	$1,296	3	$22,889	$7,630
WAYNESBORO, CITY OF	YES	NON RESIDNT	X	$286,970	$36,747	$0	2	$36,747	$18,374
WAYNESBORO, CITY OF	YES	ASSMD CONDO	B	ASSUMED CONDO	$496,362	$0	4	$496,362	$124,091
WAYNESBORO, CITY OF	YES	SINGLE FMLY	B	$32,482	$7,207	$0	2	$7,207	$3,604
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$67,340	$60,873	$10,468	5	$71,341	$14,268
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$49,361	$8,720	$3,495	3	$12,215	$4,072
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$69,948	$34,624	$5,000	4	$39,624	$9,906
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$158,000	$128,314	$79,614	4	$207,928	$51,982
WAYNESBORO, CITY OF	YES	SINGLE FMLY	A08	$64,700	$17,819	$13,095	3	$30,914	$10,305
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$134,575	$55,108	$26,086	4	$81,194	$20,298

CSPDC Repetitive Loss Structures (as of 12/31/2003)									
Community Name	Insured?	Occupancy	Zone	Building Value	Total Building Payment	Total Contents Payment	Losses	Total Paid	Average Paid
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$150,852	$39,485	$3,273	4	$42,758	$10,689
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$94,510	$17,876	$6,261	3	$24,137	$8,046
WAYNESBORO, CITY OF	YES	SINGLE FMLY	AE	$60,735	$32,873	$10,049	4	$42,922	$10,730
WAYNESBORO, CITY OF	NO	SINGLE FMLY	A08	$90,810	$115,547	$26,300	3	$141,847	$47,282
WAYNESBORO, CITY OF	NO	SINGLE FMLY	A08	$98,300	$47,142	$0	3	$47,142	$15,714
WAYNESBORO, CITY OF	NO	SINGLE FMLY	A08	$90,000	$48,422	$13,776	5	$62,197	$12,439
WAYNESBORO, CITY OF	NO	SINGLE FMLY	AE	$112,806	$40,851	$18,316	3	$59,167	$19,722
TOTAL				**$36,434,940**	**$7,600,258**	**$4,514,535**	**451**	**$12,114,793**	**$4,104,105**

Structures At Risk-Vulnerability

Structures at risk to flooding were determined by two methods. For many of the counties and cities, the CSPDC Flood Mitigation Assistance Plan lists the number of residential and industrial buildings in the floodplain. Table 7 is a summary of these at risk structures.

Table 7
Structures at Risk due to Flooding from the CSPDC Flood Mitigation Plan

Community	Houses at Risk	Housing Units	% of Housing Units
Augusta County	2,608	24,818	10.51%
Bath County	250	2,053	12.18%
**Bridgewater, Town of*	*70*	*1,850*	*3.78%*
**Broadway, Town of*	*100*	*976*	*10.25%*
**Glasgow, Town of*	*138*	*494*	*28%*
**Goshen, Town of*	*64*	*214*	*30%*
**Grottoes, Town of*	*40*	*894*	*4.47%*
Rockbridge County	703	8,486	8.28%
Rockingham County	5,017	25,355	19.79%
Staunton City	200	9,676	2.07%
Waynesboro City	958	8,332	11.50%
Total	**9,736**	**78,720**	**12.37%**

*Denotes town values that are also included in totals for the perspective County.

For those communities not covered by the CSPDC Flood Mitigation Assistance Plan, the numbers of structures at risk from flooding were determined based on the percent area of the community in the floodplain and the number of housing units from the 2000 Census. Table 8 shows the number of at risk structures for these communities.

Table 8-Structures at Risk due to Flooding Based on Percent Floodplain Area and 2000 Census Housing Units

Community	Housing Units	Total Area (sq mi)	Area in Floodplain (sq mi)	Houses at Risk	% of Housing Units
Buena Vista City	2,547	7	0.8609	313	12.29%
**Craigsville, Town of*	*474*	*1.945*	*0.158*	*39*	*8.12%*
**Dayton, Town of*	*565*	*0.798*	*0.123*	*87*	*15.41%*
**Elkton, Town of*	*919*	*1.377*	*0.227*	*151*	*16.49%*
Harrisonburg City	13,133	18	0.9746	711	5.41%
Highland County	1,131	416	8.0919	22	1.95%
Lexington City	2,232	2	0.1348	150	6.72%
**Monterey, Town of*	*141*	*0.304*	*0.011*	*25*	*17.73%*
**Mt. Crawford, Town of*	*109*	*0.345*	*0.057*	*18*	*16.52%*
**Timberville, Town of*	*770*	*0.875*	*0.11*	*97*	*12.57%*
Total	**19,043**	**443**	**10.06**	**1,196**	**6.28%**

*Denotes town values that are also included in totals for the perspective County.

Estimating Losses

Using the property values from Table 1, an estimation of the potential flood loss for each structure was developed. Losses included structure and contents damage using a method based on FEMA Benefit Cost Analysis. Contents values were estimated as 30% of the structural replacement value. Structural damage percentages for a 100-yr event were established as 11%. Contents damages were estimated as 50% greater than the structural damage percentage. These values were used to predict the damage from a 100-yr flood event for the structure. To calculate an annualized flood damage estimate, it was assumed for each structure damages began with a 25-yr event. A percentage of the 100-yr flood damage value was used for events less frequent than the 100-yr event.

For example, a parcel with 25% in the floodplain is estimated to have a structure worth $100,000 based on the community parcel database. The replacement value of the structure would be $110,000 and the contents value $33,000. Damage to the structure (11%) would be estimated at $11,000 with $1,815 in contents damage. Annual damage for the structure and contents would be estimated at $320. In order to take into account the number of structures in the floodplain (method 2), the percent of floodplain area was multiplied by the total number of housing units in the community to give the number of houses in the floodplain. The number of houses in the floodplain (from methods 1 and 2) was then multiplied to the annual damage due to flooding to give the total estimated loss for the region (table 9). From table 9, it is shown that a large percentage of the estimated losses are in counties of Augusta and Rockingham.

Table 9
CSPDC Structure Vulnerability and Estimated Losses due to Flooding.

Community	Flood Policies	Total Housing Units	Medium Home Value	Total Structure Value Vulnerability	Total Loss Estimate
Augusta County	261	24,818	$110,900	$289,227,200	$926,612
**Craigsville, Town of*	*28*	*474*	*$64,800*	*$2,495,117*	*$7,994*
Bath County	32	2,053	$79,700	$19,925,000	$63,835
Buena Vista City	91	2,547	$72,900	$22,817,700	$73,159
Harrisonburg City	88	13,133	$122,700	$87,239,700	$279,525
Highland County	12	1,131	$83,700	$1,841,400	$5,899
**Monterey, Town of*	*5*	*141*	*$84,200*	*$2,105,000*	*$6,744*
Lexington City	8	2,232	$131,900	$19,785,000	$63,571
Rockbridge County	273	8,486	$92,400	$64,957,200	$208,107
**Glasgow, Town of*	*40*	*494*	*$66,400*	*$9,163,200*	*$29,357*
**Goshen, Town of*	*13*	*214*	*$59,100*	*$3,782,400*	*$12,118*
Rockingham County	489	25,355	$107,700	$540,330,900	$1,731,085
**Bridgewater, Town of*	*57*	*1,850*	*$126,300*	*$8,841,000*	*$28,324*
**Broadway, Town of*	*19*	*976*	*$101,100*	*$10,110,000*	*$32,390*
**Dayton, Town of*	*10*	*565*	*$120,600*	*$10,502,628*	*$33,648*
**Elkton, Town of*	*25*	*919*	*$94,800*	*$14,362,028*	*$46,012*
**Grottoes, Town of*	*29*	*894*	*$90,500*	*$3,620,000*	*$11,598*
**Mt. Crawford, Town of*	*2*	*109*	*$96,700*	*$1,741,441*	*$5,579*
**Timberville, Town of*	*8*	*770*	*$82,300*	*$7,966,640*	*$25,523*
Staunton City	114	9,676	$87,500	$17,500,000	$56,066
Waynesboro City	185	8,332	$89,300	$85,549,400	$274,079
Total	**1,789**	**97,763**		**$1,149,173,500**	**$3,681,938**

*Denotes town values that are also included in totals for the perspective County.

Critical Facilities

The impacts of flooding on critical facilities can significantly increase the overall effect of a flood event on a community. It should be noted that these facilities have been determined to be in the floodplain using Geographic Information Systems (GIS) and should be used only as a planning tool. In order to accurately determine if a structure is actually in the floodplain, site-specific information must be available. Fifty-two critical facilities were determined to be within the FEMA designated floodplain. Table10 denotes the critical facilities that are located within or in close proximity to the FEMA designated floodplains. Using a GIS, the critical facility points were intersected with the FEMA flood zones. A 30-foot buffer on the facilities provided a radial distance from the center of the building that was used to determine the proximity to the floodplain. While Table 10 shows fifty-two critical facilities are located near or in the floodplain, there is great diversity in the type of facility located within or in close proximity to the floodplain. See Appendix A for a listing of the critical facilities within the floodplain.

Table 10
CSPDC Critical Facilities in mapped FEMA floodplain.

Critical Facilities within FEMA designated Floodplain	
Type	**Number of Facilities (Historic)**
Church	28 (6)
Commercial	4
Government	4
Industrial	6
School	9 (5)
Utilities	1
Total	**52**

4 - Drought (High Ranking)

Hazard History

Table 11 includes descriptions of major droughts that have occurred in Virginia and the Central Shenandoah PDC. Events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire planning area.

Table 11
CSPDC Drought Hazard History

Date	Damages
1976 - 1977	Ten months of below average precipitation. The drought began in November of 1976 when rainfall totaled to only 50% to 75% of normal. During the rest of the winter, the storms tracked across the Gulf. During the spring and summer the storms tracked across the Great Lakes. These weather patterns created significant drought throughout most of Virginia.
5/1980 - 8/1980	Warm and dry conditions prevailed through the beginning of the summer. June precipitation data show that much of Virginia received record low rainfall. No crop damage reported.
1985 - 1986	Very little rainfall began in December and the trend continued throughout the summer. Total precipitation for January and February was 2 inches. Palmer Index values dropped below -2 by June. High temperatures along with scarce precipitation created a drought that lasted well into the fall.
6/1988 - 7/1988	A heat wave over the southeast produced warm and dry conditions over much of Virginia. Although the news reported stories of a drought in Virginia, the Drought Monitoring Team never stated in a report that these conditions were indicative of a drought. Palmer Drought Index values were above -2.
5/1993 - 8/1993	Very warm temperatures and little rain were noted beginning June 5, 1993. Precipitation shortages were greater than five inches for southwestern and southeastern Virginia from May through July. Surface soil moisture levels were low enough to result in significant agricultural damage. However groundwater remained at normal levels.
6/1999- 9/1999	Northern Virginia and Shenandoah Valley experienced one of the worst droughts of the 20th Century. Record low stream flows on the Rappahannock. Crops, cattle and fisheries were all suffering. The drought was beginning to move into the Piedmont.
2001-2004	Beginning in the winter of 2001 the Mid-Atlantic region began to show long-term drought conditions. The National Weather Service made reports of moisture starved cold fronts that would continue throughout the winter. Stream levels were below normal with record lows observed at stream gages for the York, James, and Roanoke River Basins. By November of 2002 the U.S Secretary of Agriculture had approved 45 counties for primary disaster designation, while 36 requests remained pending.

Hazard Profile

A drought is a period of abnormally dry weather that persists long enough to produce serious effects like crop damage, water supply shortages, etc. The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area as well as the demands of human activity and agriculture on water supplies. Drought can affect vast regions and large population numbers. A drought is a silent but very damaging phenomenon and unlike other natural disasters can last for years. Drought can ruin local and regional economies that are agricultural and tourism based. Drought increases the risk of other hazards like fire, flash flood, and possible landslide and debris flow. Droughts are a normal and recurrent feature of climate. Statistics indicate that roughly every 22 years, a major drought occurs in the United States, most seriously affecting the Prairie and Midwestern states. The disastrous drought of the 1930's during which a large areas of the Great Plains became known as the Dust Bowl, is one example.

Droughts are measured on the Palmer Drought Severity Index (PDSI) which tracks moisture conditions. The PDSI defines an interval of time, generally in months or years, during which the actual moisture supply at a given place falls short of the climatically appropriate moisture supply. The range on the PDSI is from -4.0 (extremely dry) to +4.0 (excessively wet), with the mid-range (-2.0 to +2.0) representing the normal or near normal conditions.

Table 12 provides a summary of drought categories and impacts. Notice that water restrictions start off as voluntary and then become required. For excessive heat, the National Weather Service utilizes heat index thresholds as criteria for the issuance of heat advisories and excessive heat warnings.

Table 12
Drought Severity Classification

Category	Description	Possible Impacts
D0	Abnormally Dry	Going into drought: short-term dryness slowing planting, growth of crops or pastures; fire risk above average. Coming out of drought: some lingering water deficits; pastures or crops not fully recovered.
D1	Moderate Drought	Some damage to crops, pastures; fire risk high; streams, reservoirs, or wells low, some water shortages developing or imminent, voluntary water use restrictions requested
D2	Severe Drought	Crop or pasture losses likely; fire risk very high; water shortages common; water restrictions imposed
D3	Extreme Drought	Major crop/pasture losses; extreme fire danger; widespread water shortages or restrictions
D4	Exceptional Drought	Exceptional and widespread crop/pasture losses; exceptional fire risk; water emergencies created by shortages of water in reservoirs, streams and wells.

Vulnerability Analysis

The 1990 U.S. Census contained detailed information about source of water per Census block group. For purposes of this analysis, it was assumed that areas with populations having less than 25% of public/private water systems had a high vulnerability ranking. When a drought occurs, these areas would likely have a larger impact since most homes receive their water from wells, which may dry up during a drought. Table 13 provides a summary of the 1990 population in three categories of drought vulnerability. Note that the table contains information specific to the towns; this information has also been included with the county totals. As a result of using 1990 U.S. Census data, at the track level, there are some discrepancies with the town boundaries. Boundary adjustments into "high vulnerability" areas are a result of the older census data, which is a data limitation issue. Future updates of this plan will use, if available, the most current census data for water systems. Based on the percentage of the population in the high vulnerability category, Highland County has the highest percentage of people vulnerable to drought (65%) followed by the counties of Rockbridge (53%) and Rockingham (49%). Figure 5 shows these categories for each of the communities.

Table 13
CSPDC Drought Vulnerability (from 1990 Census).

Percent Population with Public/Private Water Systems				
Community	**High (< 25%)**	**Medium (25% - 50%)**	**Low (> 50 %)**	**Total**
Augusta County	18,936	8,105	27,636	**54,677**
**Craigsville, Town of*	*0*	*0*	*812*	*812*
Bath County	1,333	851	2,615	**4,799**
Buena Vista City	0	0	6,406	**6,406**
Harrisonburg City	0	0	30,707	**30,707**
Highland County	1,722	913	0	**2,635**
**Monterey, Town of*	*0*	*222*	*0*	*222*
Lexington City	0	0	6,959	**6,959**
Rockbridge County	9,788	6,409	2,153	**18,350**
**Glasgow, Town of*	*0*	*0*	*1140*	*1140*
**Goshen, Town of*	*0*	*366*	*0*	*366*
Rockingham County	28,040	11,204	18,238	**57,482**
**Bridgewater, Town of*	*0*	*0*	*3,918*	*3918*
**Broadway, Town of*	*0*	*50*	*1159*	*1209*
**Dayton, Town of*	*0*	*0*	*921*	*921*
**Elkton, Town of*	*0*	*85*	*1850*	*1935*
**Grottoes, Town of*	*0*	*0*	*1455*	*1455*
**Mt. Crawford, Town of*		*228*	*0*	*228*
**Timberville, Town of*	*0*	*1596*	*0*	*1596*
Staunton City	0	0	24,461	**24,461**
Waynesboro City	0	0	18,549	**18,549**
Total	**59,819**	**27,482**	**137,724**	**225,025**

*Denotes town values that are also included in totals for the perspective County.

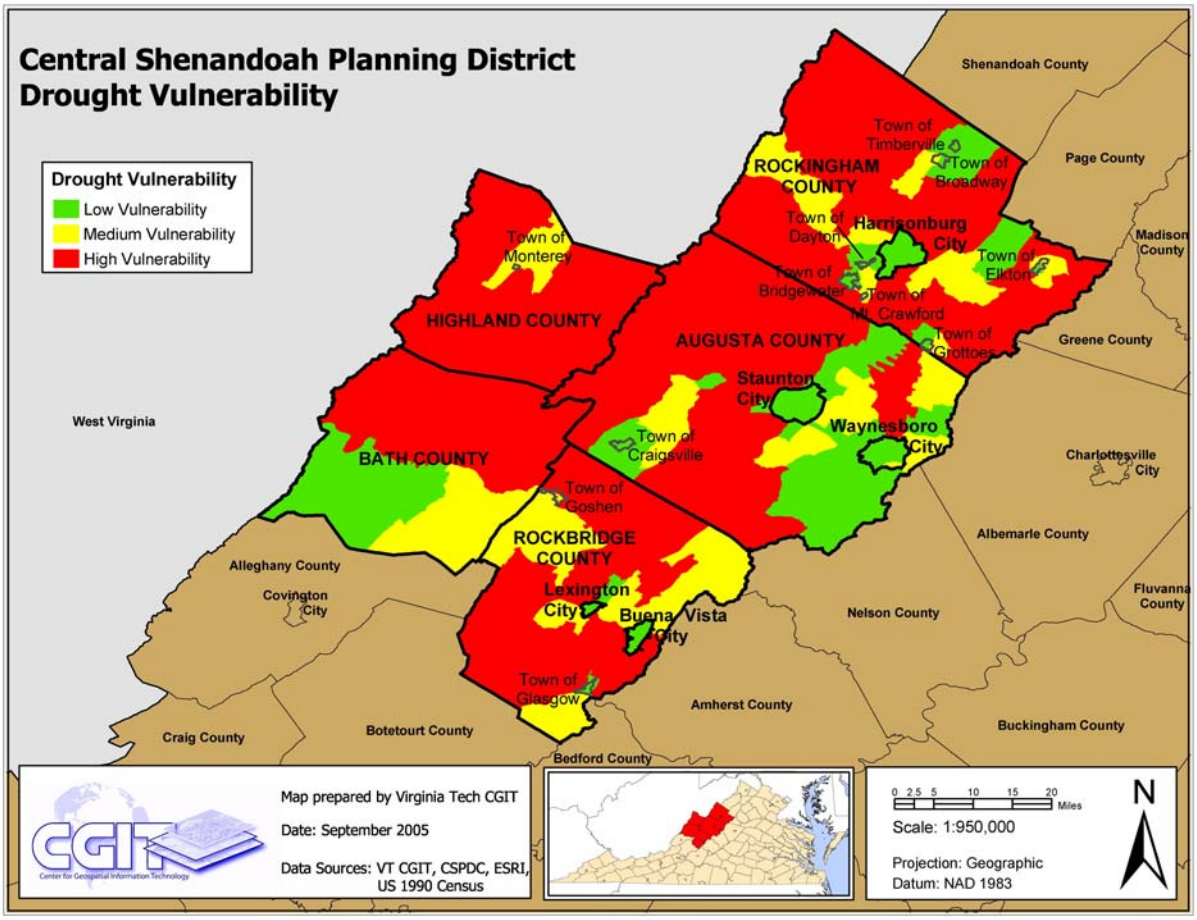

Figure 5. CSPDC Drought Vulnerability.

5 – Hurricane (High Ranking) *Wind Impacts Only*

Hazard History

Listed below are major hurricane and wind events that have occurred in the Central Shenandoah PDC. See Table 4, Section 3 and Appendix A on flooding for detailed information on the flooding impacts of hurricanes in the region.

- Hurricane Camille - August 1969
- Hurricane Agnes - June 1972
- Hurricane Juan - November 1985
- Hurricane Fran - September 1996
- Hurricane Isabel – September 2003

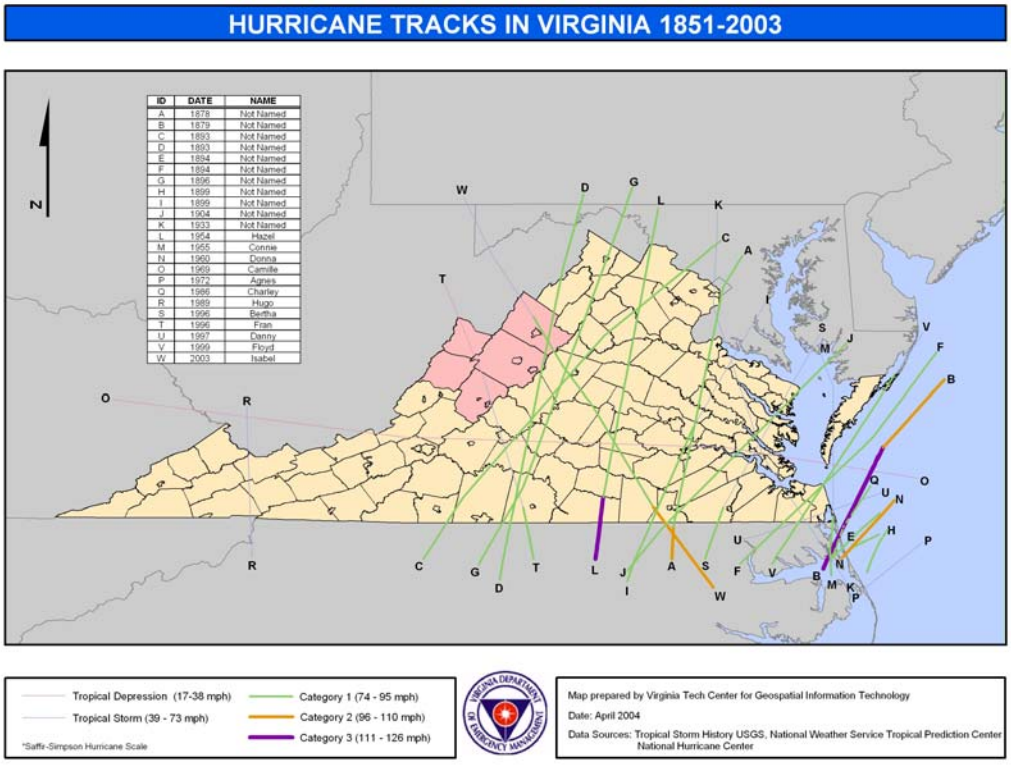

Figure 6. Virginia Hurricane Tracks (from VDEM).

The Commonwealth of Virginia's Standard Hazard Mitigation Plan includes hurricane tracks in Virginia spanning from 1851 to 2003 (Figure 6). The hurricane track map gives an idea of the historical occurrences in the Central Shenandoah PDC region. The hurricane in 1893, which is "Not Named", tracked through the eastern tip of Rockingham County with a Saffir-Simpson hurricane category of 1. Other hurricanes that have tracked through the Central Shenandoah PDC region include tropical depression Fran and Hurricane Isabel (category 1 and tropical storm). Hurricanes that have not tracked through the region still have had a considerable impact on the region. Notably secondary impacts have caused loss of life, injury, property damage and widespread infrastructure damage (i.e. power and phone disruptions).

Hazard Profile

A tropical cyclone is the generic term for a non-frontal synoptic scale low-pressure system over tropical or sub-tropical waters with organized convection and definite cyclonic surface wind circulation. Depending on strength, they are classified as hurricanes or tropical storms. Tropical cyclones involve both atmospheric and hydrologic characteristics, such as severe windstorms, surge flooding, high waves, coastal erosion, extreme rainfall, thunderstorms, lightning, and, in some cases, tornadoes. Storm surge flooding can push inland, and riverine flooding associated with heavy inland rains can be extensive. High winds are associated with hurricanes, with two significant effects: widespread debris due to damaged and downed trees and damaged buildings; and power outages.

Secondary Hazards

Secondary hazards from a hurricane event could include high winds, flooding, heavy waves, and tornadoes. Once inland, the hurricane's band of thunderstorms produces torrential rains and, sometimes, tornadoes. A foot or more of rain may fall in less than a day causing flash floods and mudslides. The rain eventually drains into the large rivers, which may still be flooding for days after the storm has passed. The storm's driving winds can topple trees, utility poles, and damage buildings. Communication and electricity is lost for days and roads are impassable due to fallen trees and debris.

Hurricane Damage Scale

Hurricanes are categorized by the Safer-Simpson Hurricane Damage Scale listed below (Table 14). Following the table are detailed descriptions of each category and the potential damage caused by each.

Table 14
Saffir-Simpson Hurricane Damage Scale

Hurricane Category	Sustained Winds (mph)	Damage Potential	Description
1	74 – 95	Minimal	Minimal damage to unanchored mobile homes along with shrubbery and trees. There may be pier damage and coastal road flooding, with storm surge 4-5 feet about average.
2	96 – 110	Moderate	Moderate damage potential to mobile homes and piers, as well as significant damage to shrubbery and tress with some damages to roofs, doors and windows. Impacts include flooding 2-4 hours before arrival of the hurricane in coastal and low lying areas. Storm surge can be 6-8 feet above average.
3	111 – 130	Extensive	Extensive damage potential. There will be structural damage to small residences and utility buildings. Extensive damage is to mobile homes and trees and shrubbery. Impacts include flooding 3-5 hours before the arrival of the hurricane cutting off the low lying escape routes. Coastal flooding has the potential to destroy the small structures, with significant damage to larger structures as a result of the floating debris. Land that is lower than 5 feet below mean sea level can be flooded 8 or more miles inland. Storm surge can be 6-12 feet above average.
4	131 – 155	Extreme	Extreme damage potential. Curtain wall failure as well as roof structure failure. Major damage to lower floors near the shoreline. Storm surge generally reaches 13-18 feet above average.
5	> 155	Catastrophic	Severe damage potential. Complete roof failure on residence and industrial structures, with complete destruction of mobile homes. All shrubs, trees and utility lines blown down. Storm surge is generally greater than 18 feet above average.

Vulnerability Analysis

HAZUS-MH

HAZUS-MH was used to complete the wind analysis for vulnerability and loss estimates. The HAZUS software has been developed by FEMA and the Nation Institute of Building Sciences. Level 1, with default parameters, was used for the analysis done in this plan. For analysis purposes, the U.S. Census tracks are the smallest extent in which the model runs. The results of this analysis are captured in the vulnerability analysis and loss estimation.

HAZUS-MH uses historical hurricane tracks and computer modeling to identify the probable tracks of a range of hurricane events at the U.S. Census Track level. Results from the model are used to develop the annualized damages. The impacts of various events are then combined to create a total annualized loss or the expected value of loss in any given year.

The FEMA HAZUS-MH model was used to determine hurricane wind vulnerability and losses. The Hurricane Wind Probabilistic Model with HAZUS-MH predicts hurricane tracks, based on historical hurricane, for different return periods. Wind gust ranges for three return periods are as follows:

- 50-yr wind gust range-56-62 mph
- 100-yr wind gust range-68-71 mph
- 1000-yr wind gust range-94-98 mph

The maximum wind gust for each probabilistic hurricane track is used to predict structure vulnerability and losses using regional statistics for different building stocks and occupancy. The following sections will highlight the specifics for building vulnerability for different building types and occupancies.

Building Types

Table 15 illustrates the probabilistic building stock exposure by building type to hurricanes. For the Central Shenandoah PDC region, wood-frame buildings account for a large percentage of the building stock. Table 16 illustrates the building stock exposure broken down by the type of occupancy. From the table, 83% of the building stock for the Central Shenandoah PDC region is considered residential, with approximately 14% of the building stock coming from commercial and industrial.

HAZUS-MH hurricane model only conducts analysis at the U.S. Census track level; which is larger than all of the towns in the region. Town exposure has been estimated based on the percentage of the housing units in the County.

Table 15
Building Stock Exposure by Building Type (from HAZUS-MH).

Building Stock Exposure by Building Type						
	Wood	**Masonry**	**Concrete**	**Steel**	**MH**	**TOTAL**
Augusta County	$2,348,057	$934,772	$99,713	$307,691	$117,382	**$3,807,615**
**Craigsville, Town of*	*$35,034*	*$13,947*	*$1,488*	*$4,591*	*$1,751*	***$56,811***
Bath County	$300,188	$121,687	$29,210	$35,166	$8,248	**$494,499**
Buena Vista City	$237,530	$96,936	$12,134	$23,575	$4,357	**$374,532**
Harrisonburg City	$1,160,939	$737,195	$264,211	$484,710	$10,683	**$2,657,738**
Highland County	$151,922	$55,048	$1,947	$8,697	$7,744	**$225,358**
**Monterey, Town of*	*$9,465*	*$3,430*	*$121*	*$542*	*$482*	***$14,040***
Lexington City	$221,457	$144,956	$64,200	$79,922	$764	**$511,299**
Rockbridge County	$797,923	$307,604	$25,171	$83,094	$45,955	**$1,259,747**
**Glasgow, Town of*	*$40,111*	*$15,463*	*$1,265*	*$4,177*	*$2,310*	***$63,326***
**Goshen, Town of*	*$15,569*	*$6,002*	*$491*	*$1,621*	*$897*	***$24,580***
Rockingham County	$2,401,488	$946,000	$86,808	$229,962	$108,452	**$3,772,710**
**Bridgewater, Town of*	*$184,495*	*$72,677*	*$6,669*	*$17,667*	*$8,332*	***$289,840***
**Broadway, Town of*	*$77,727*	*$30,618*	*$2,810*	*$7,443*	*$3,510*	***$122,108***
**Dayton, Town of*	*$47,657*	*$18,773*	*$1,723*	*$4,564*	*$2,152*	***$74,869***
**Elkton, Town of*	*$72,408*	*$28,523*	*$2,617*	*$6,934*	*$3,270*	***$113,752***
**Grottoes, Town of*	*$74,961*	*$29,529*	*$2,710*	*$7,178*	*$3,385*	***$117,763***
**Mt. Crawford, Town of*	*$9,007*	*$3,548*	*$326*	*$862*	*$407*	***$14,149***
**Timberville, Town of*	*$61,664*	*$24,291*	*$2,229*	*$5,905*	*$2,785*	***$96,873***
Staunton City	$943,574	$440,583	$85,584	$156,301	$1,012	**$1,627,054**
Waynesboro City	$763,567	$324,758	$38,056	$103,054	$6,806	**$1,236,241**
TOTAL	**$9,954,743**	**$4,356,340**	**$729,483**	**$1,573,656**	**$340,685**	**$16,954,906**
						All values are in thousands of dollars

*Denotes town values that are also included in totals for the perspective County.

Table 16
Building Stock Exposure by General Occupancy (from HAZUS-MH).

Building Stock Exposure By General Occupancy								
Community	**Residential**	**Commercial**	**Industrial**	**Agri.**	**Religion**	**Gov't**	**Ed.**	**Total**
Augusta County	$3,217,697	$326,175	$194,572	$20,448	$35,973	$3,908	$8,845	**$3,807,618**
** Craigsville, Town of*	*$48,009*	*$4,867*	*$2,903*	*$305*	*$537*	*$58*	*$132*	***$56,811***
Bath County	$452,878	$21,892	$7,852	$907	$4,392	$2,607	$3,971	**$494,499**
Buena Vista City	$332,182	$25,453	$9,893	$0	$5,015	$1,265	$724	**$374,532**
Harrisonburg City	$1,820,119	$527,791	$135,296	$14,926	$39,652	$3,703	$116,243	**$2,657,730**
Highland County	$206,296	$12,188	$2,437	$1,790	$1,335	$1,099	$213	**$225,358**
** Monterey, Town of*	*$12,853*	*$759*	*$152*	*$112*	*$83*	*$68*	*$13*	***$14,040***
Lexington City	$384,287	$88,390	$1,165	$259	$8,293	$3,875	$25,032	**$511,301**
Rockbridge County	$1,098,775	$76,022	$54,564	$7,212	$15,469	$4,433	$3,267	**$1,259,742**
** Glasgow, Town of*	*$55,234*	*$3,822*	*$2,743*	*$363*	*$778*	*$223*	*$164*	***$63,326***
** Goshen, Town of*	*$21,439*	*$1,483*	*$1,065*	*$141*	*$302*	*$86*	*$64*	***$24,580***
Rockingham County	$3,308,546	$242,667	$106,619	$52,367	$47,450	$5,857	$9,211	**$3,772,717**
** Bridgewater, Town of*	*$254,180*	*$18,643*	*$8,191*	*$4,023*	*$3,645*	*$450*	*$708*	***$289,840***
** Broadway, Town of*	*$107,085*	*$7,854*	*$3,451*	*$1,695*	*$1,536*	*$190*	*$298*	***$122,108***
** Dayton, Town of*	*$65,658*	*$4,816*	*$2,116*	*$1,039*	*$942*	*$116*	*$183*	***$74,869***
** Elkton, Town of*	*$99,757*	*$7,317*	*$3,215*	*$1,579*	*$1,431*	*$177*	*$278*	***$113,753***
** Grottoes, Town of*	*$103,275*	*$7,575*	*$3,328*	*$1,635*	*$1,481*	*$183*	*$288*	***$117,763***
** Mt. Crawford, Town of*	*$12,409*	*$910*	*$400*	*$196*	*$178*	*$22*	*$35*	***$14,149***
** Timberville, Town of*	*$84,955*	*$6,231*	*$2,738*	*$1,345*	*$1,218*	*$150*	*$237*	***$96,873***
Staunton City	$1,348,576	$213,605	$16,783	$1,884	$22,150	$8,174	$15,886	**$1,627,058**
Waynesboro City	$1,039,554	$153,293	$23,731	$5,156	$13,249	$57	$1,198	**$1,236,238**
TOTAL	**$14,073,764**	**$1,751,752**	**$583,213**	**$117,381**	**$205,108**	**$36,702**	**$186,988**	**$16,954,907**
								All values are in thousands of dollars

*Denotes town values that are also included in totals for the perspective County.

Critical Facilities

Vulnerability to critical facilities from hurricane winds is fairly low throughout the region as a result of the low annualized hurricane wind losses.

Loss Estimation

Figure 7 shows that most of the region's annual probabilistic hurricane losses are less than $20,000 per Census tract. The City of Lexington has a high annual hurricane loss (greater than $40,000). A majority of the areas in the $20,000 to $40,000 loss range are located in the valley region of the PDC, where most of the population is centralized. Annualized losses

were estimated using the FEMA MAZUS-MH model. National forests and parks dominant the Central Shenandoah Planning District Commission, as a result the hurricane losses are reduced due to the fact that most people do not live in the national forest areas.

Table 17 provides the loss estimations from HAZUS-MH by building type. As noted earlier, wood structures compose the majority of the structures, and also account for the majority of the losses (63%). Table 18 shows the loss by occupancy type. Note that differences between the totals in the tables are due to rounding in the calculations in HAZUS-MH.

HAZUS-MH hurricane model only conducts analysis at the U.S. Census track level; which is larger than all of the towns in the region. Town building stock loss has been estimated based on the percentage of the housing units in the County.

Table 17
Building Stock Loss by Building Type (from HAZUS-MH)

Building Stock Loss by Building Type						
Community	**Wood**	**Masonry**	**Concrete**	**Steel**	**MH**	**TOTAL**
Augusta County	$158.19	$61.16	$2.65	$10.57	$9.93	**$242.49**
** Craigsville, Town of*	*$2.36*	*$0.91*	*$0.04*	*$0.16*	*$0.15*	***$3.62***
Bath County	$12.63	$5.06	$0.35	$0.76	$0.51	**$19.31**
Buena Vista City	$20.29	$8.30	$0.35	$1.14	$0.48	**$30.56**
Harrisonburg City	$77.48	$53.11	$6.27	$18.85	$1.05	**$156.76**
Highland County	$7.33	$2.54	$0.03	$0.18	$0.49	**$10.58**
** Monterey, Town of*	*$0.46*	*$0.16*	*$0.00*	*$0.01*	*$0.03*	***$0.66***
Lexington City	$23.43	$12.11	$1.99	$4.48	$0.10	**$42.10**
Rockbridge County	$54.59	$20.99	$0.70	$3.01	$4.17	**$83.45**
** Glasgow, Town of*	*$2.74*	*$1.06*	*$0.04*	*$0.15*	*$0.21*	***$4.19***
** Goshen, Town of*	*$1.07*	*$0.41*	*$0.01*	*$0.06*	*$0.08*	***$1.63***
Rockingham County	$149.86	$58.13	$1.76	$6.93	$8.61	**$225.30**
** Bridgewater, Town of*	*$11.51*	*$4.47*	*$0.14*	*$0.53*	*$0.66*	***$17.31***
** Broadway, Town of*	*$4.85*	*$1.88*	*$0.06*	*$0.22*	*$0.28*	***$7.29***
** Dayton, Town of*	*$2.97*	*$1.15*	*$0.03*	*$0.14*	*$0.17*	***$4.47***
** Elkton, Town of*	*$4.52*	*$1.75*	*$0.05*	*$0.21*	*$0.26*	***$6.79***
** Grottoes, Town of*	*$4.68*	*$1.81*	*$0.05*	*$0.22*	*$0.27*	***$7.03***
** Mt. Crawford, Town of*	*$0.56*	*$0.22*	*$0.01*	*$0.03*	*$0.03*	***$0.84***
** Timberville, Town of*	*$3.85*	*$1.49*	*$0.05*	*$0.18*	*$0.22*	***$5.79***
Staunton City	$75.07	$33.60	$2.02	$6.46	$0.10	**$117.25**
Waynesboro City	$68.42	$30.56	$1.31	$5.27	$0.75	**$106.32**
Total	**$686.86**	**$300.87**	**$17.91**	**$59.55**	**$28.55**	**$1,093.75**
						**All values are in thousands of dollars*

*Denotes town values that are also included in totals for the perspective County.

Table 18
Building Stock Loss by General Occupancy (from HAZUS-MH)

Building Stock Loss By General Occupancy								
Community	**Residential**	**Commercial**	**Industrial**	**Agriculture**	**Religion**	**Government**	**Education**	**Total**
Augusta County	$219.57	$11.76	$9.75	$0.89	$0.99	$0.16	$0.27	**$243.39**
** Craigsville, Town of*	*$3.28*	*$0.18*	*$0.15*	*$0.01*	*$0.01*	*$0.00*	*$0.00*	***$3.63***
Bath County	$18.66	$0.39	$0.14	$0.03	$0.07	$0.05	$0.06	**$19.41**
Buena Vista City	$28.27	$1.22	$0.84	$0.00	$0.20	$0.06	$0.03	**$30.62**
Harrisonburg City	$121.09	$20.34	$8.56	$0.81	$1.26	$0.19	$4.66	**$156.91**
Highland County	$10.19	$0.25	$0.05	$0.05	$0.02	$0.03	$0.00	**$10.60**
** Monterey, Town of*	*$0.63*	*$0.02*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	*$0.00*	***$0.66***
Lexington City	$34.69	$5.31	$0.06	$0.02	$0.39	$0.24	$1.47	**$42.17**
Rockbridge County	$76.78	$2.79	$3.00	$0.34	$0.47	$0.24	$0.11	**$83.73**
** Glasgow, Town of*	*$3.86*	*$0.14*	*$0.15*	*$0.02*	*$0.02*	*$0.01*	*$0.01*	***$4.21***
** Goshen, Town of*	*$1.50*	*$0.05*	*$0.06*	*$0.01*	*$0.01*	*$0.00*	*$0.00*	***$1.63***
Rockingham County	$210.67	$7.35	$3.57	$2.31	$1.27	$0.25	$0.31	**$225.72**
** Bridgewater, Town of*	*$16.18*	*$0.56*	*$0.27*	*$0.18*	*$0.10*	*$0.02*	*$0.02*	***$17.34***
** Broadway, Town of*	*$6.82*	*$0.24*	*$0.12*	*$0.07*	*$0.04*	*$0.01*	*$0.01*	***$7.31***
** Dayton, Town of*	*$4.18*	*$0.15*	*$0.07*	*$0.05*	*$0.03*	*$0.00*	*$0.01*	***$4.48***
** Elkton, Town of*	*$6.35*	*$0.22*	*$0.11*	*$0.07*	*$0.04*	*$0.01*	*$0.01*	***$6.81***
** Grottoes, Town of*	*$6.58*	*$0.23*	*$0.11*	*$0.07*	*$0.04*	*$0.01*	*$0.01*	***$7.05***
** Mt. Crawford, Town of*	*$0.79*	*$0.03*	*$0.01*	*$0.01*	*$0.00*	*$0.00*	*$0.00*	***$0.85***
** Timberville, Town of*	*$5.41*	*$0.19*	*$0.09*	*$0.06*	*$0.03*	*$0.01*	*$0.01*	***$5.80***
Staunton City	$105.78	$8.84	$0.82	$0.10	$0.80	$0.46	$0.67	**$117.48**
Waynesboro City	$95.88	$7.95	$1.45	$0.29	$0.56	$0.00	$0.07	**$106.21**
Total	**$977.16**	**$68.20**	**$29.38**	**$5.39**	**$6.36**	**$1.76**	**$7.73**	**$1,095.99**
								** All values are in thousands of dollars*

*Denotes town values that are also included in totals for the perspective County.

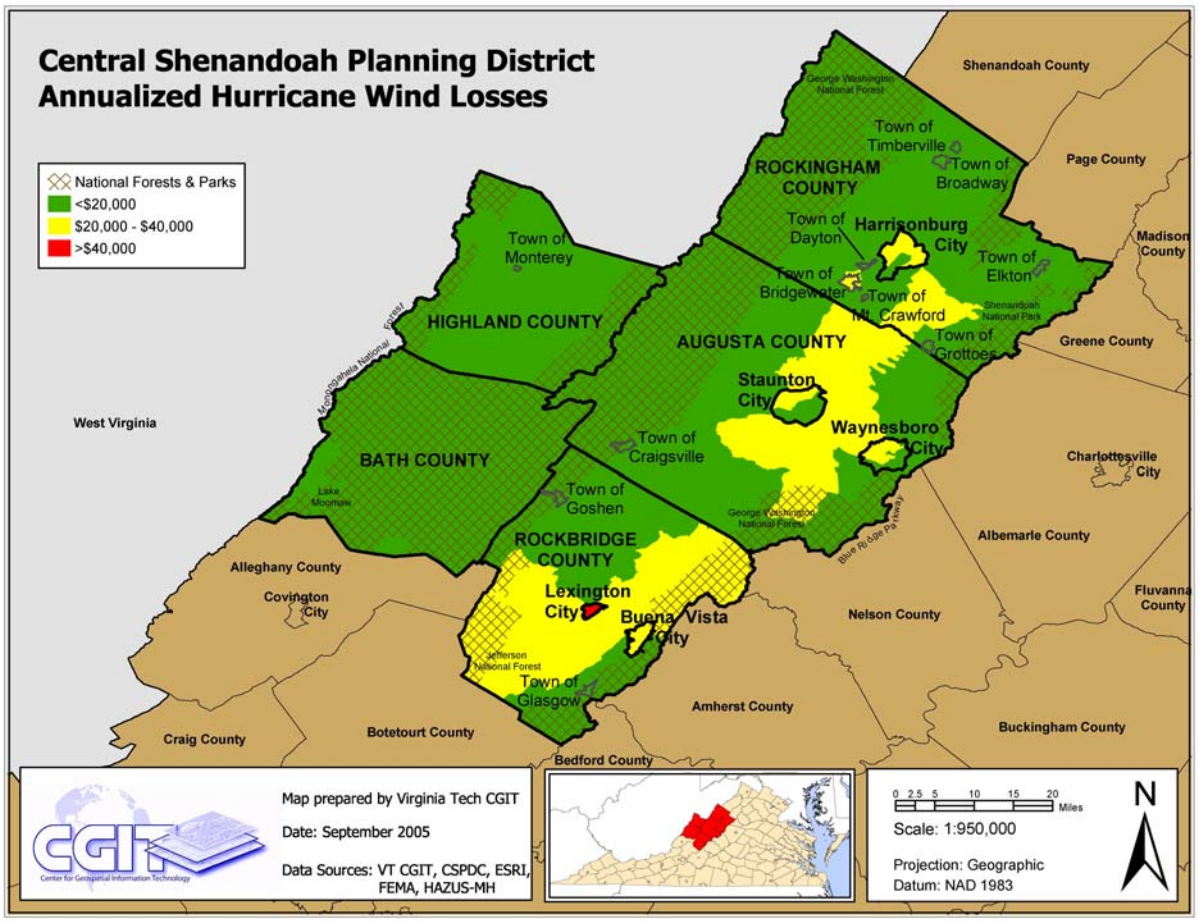

Figure 7. CSPDC Annualized Total Hurricane Loss Estimate.

6 - Severe Winter Storm (High Ranking)

Hazard History

Listed below in Table 19 are major winter storm events that have occurred in the Central Shenandoah PDC. Major events have been broken down by the date of occurrence and when available, by individual community descriptions. When no community specific description is available, the general description should be used as representing the entire planning area.

Table 19
CSPDC Severe Winter Weather Hazard History

Date	Damages
January 28, 1772	A severe snowstorm struck the Mid-Atlantic, dropping anywhere from 30-36 inches across the region. The storm became known as the "Washington and Jefferson" snowstorm because they were mentioned in both their diaries.
January 15, 1831	Snows of over 13 inches fell on the Shenandoah Valley.
January 19, 1857	Extreme cold hampered cleanup from a 12+ inch snowfall. The storm also brought high winds with the snowfall, and a prolonged period of near-zero temperatures froze all rivers in the state.
February, 1899	The Great Arctic Outbreak and Great Eastern Blizzard brought the harshest winter conditions ever experienced to the region. Mail service was postponed, countless pipes burst and railroads were shut down, causing fear that coal supplies would run out. **Harrisonburg:** 14" of snow, temperature of -23°F recorded **Highland County:** temperature of -29°F recorded in Monterey **Lexington:** temperature of -9°F recorded, North River froze completely over **Rockingham County:** 30" of snow in parts of the county, temperature of -36°F recorded in Timberville, temperature of -32°F recorded in Edom, temperature of -40°F recorded in Brock's Gap **Staunton:** 18" of snow, temperature of -18°F recorded
January 14, 1912	An Arctic cold wave struck the region with subzero temperatures. Across the area, water pipes froze, kitchen ranges exploded, trains were delayed, and thousands of birds and small animals died. **Harrisonburg:** temperature of -15°F recorded **Rockingham County:** temperature of -18°F recorded at Bridgewater, temperature of -18°F recorded at Dayton, temperature of -20°F recorded at McGaheysville **Staunton:** temperature of -25°F recorded. One man froze to death.
November 25, 1938	An average of 6" of snow fell across the Shenandoah Valley. **Rockingham County:** Between 50 and 75 cars were stranded on Rt. 33. Many people were traveling during this Thanksgiving holiday weekend.

Date	Damages
March 5-9, 1962	A severe Nor'easter struck the entire east coast, dumping especially heavy snow on western Virginia. **Harrisonburg:** 20" of snow. **Lexington:** 20" of snow fell. **Rockingham County:** 27" of snow fell, stranding travelers overnight on U.S. Rt. 11 near Lacey Springs. **Staunton:** 26" of snow fell.
March 26, 1978	An Easter weekend ice storm brought branches and whole trees crashing down onto power lines, with over 1" of ice accumulating in some places. Over 30,000 in the Shenandoah Valley were without power, and over 2,000 were without telephone service. Radio stations were knocked off the air and many basements were flooded.
February 11, 1983	The Blizzard of '83 struck Virginia, dropping heavy snow with drifts up to 6 feet high. **Augusta County:** 18-20" of snow fell. **Harrisonburg:** 20" of snow fell. James Madison University and Eastern Mennonite University were closed, several tractor trailers jack-knifed on I-81. **Lexington:** 18" of snow fell. **Rockbridge County:** 15-24" of snow fell.
March 13-14, 1993	The Storm of the Century struck the east coast, causing 4 feet of snow in some areas and drifts of up to 15 feet. 150 Americans lost their lives to the storm. In the Central Shenandoah region, the storm dropped between 12" and 22" of snow, with near hurricane-force winds creating drifts of 8' to 10' deep. Extremely low wind chills caused problems for farmers trying to feed livestock and drifts prevented farmers trying to move the animals to sheltered places. **Harrisonburg:** Roofs of 2 businesses collapsed under the weight of the 10' snow drifts. **Rockbridge County:** 12"-22" of snow fell and 5,000 people lost power. **Rockingham County:** 13"-22" of snow fell; winds of up to 70 m.p.h. caused drifts of 6'-7'. **Staunton:** 18" of snow fell and 200 people were without power. The National Guard was deployed in Staunton.
February 10-11, 1994	A severe ice storm struck Virginia, bringing 1"-3" of solid ice, causing $61 million dollars in damage prompting the governor and President Clinton to declare the state a disaster area. Roads were treacherous across the Central Shenandoah region, where 24 out of the past 54 days had had winter precipitation.
January 6-13, 1996	The Blizzard of 1996 struck the east coast, killing 40. The governor declared a State of Emergency in Virginia, with the hardest hit area being the Shenandoah Valley, with over 40" of snow reported in areas of Shenandoah National Park. The central Shenandoah Valley area reported an average of 28"-30" of snowfall. Local governments also declared states of emergency and all non-essential travel was banned. VDOT needed crawler tractors to plow the snow in higher elevations because the snow was too deep for regular plows. **Highland:** 24"-30" of snowfall was reported. **Staunton:** The National Guard's humvees were used by rescue personnel to assist with emergency calls.

Hazard Profile

Winter storms may include a variety of cold weather conditions such as heavy snowfall, extreme cold temperatures, freezing rain, sleet, ice and high winds. Blizzards are a type of winter storm with high winds and considerable falling or blowing snow. Winter storms may last from just a few hours to several days and affect our entire region. The impacts of winter storms include downed power lines and trees, hazardous walking and driving conditions, road closures, and business, government facilities and school closures. Health risks include hypothermia and frostbite if exposed to winter storm conditions and heart attacks due to exertion. Winter storms are considered deceptive killers because most deaths are not directly related to the actual storm event. The leading cause of death and injury during winter storms is automobile accidents when freezing rain and sleet cause road surfaces to become extremely treacherous and dangerous to motorists. Other dangers related to winter weather and extreme cold include exposure, hypothermia and asphyxiation due to improper use of heating systems. House fires occur more frequently in the winter months and during winter storms because of the use of alternative heating sources. Frozen water lines and limited access to waterlines poses a significant risk for fighting fires in the winter weather. Injury or death caused by chain-saw accidents and electrocution are also possible in the aftermath of the winter storm as residents try to remove fallen trees and power lines.

Winter storms also impact our economy. Public funds are generally associated with labor and equipment costs for snow removal, road clean-up and repair and utility restoration. Business losses are attributed to closures and the inability of employees and customers to travel. Electrical, communication and utility disruption also impact the private sector. Buildings may be damaged or destroyed when heavy snow loads collapse roofs. The agricultural economy can also suffer as a result of winter storms especially those that occur later in the season affecting crops and livestock.

Predictability and Frequency

Winter storms can be a combination of heavy snowfall, high winds, ice and extreme cold. These are classified as extra-tropical cyclones that originate as mid-latitude depressions. Winter weather impacts the Central Shenandoah between the months of November and April, with varied intensities from east to west. In order to create a winter weather hazard potential map that captures this variability, gridded climate data was obtained from the Climate Source and through the VirginiaView program. This data was developed by the Oregon State University Spatial Climate Analysis Service (SCAS) using **PRISM** (**P**arameter-elevation **R**egressions on **I**ndependent **S**lopes **M**odel). This climate mapping system is an analytical tool that uses point weather station observation data, a digital elevation model, and other spatial data sets to generate gridded estimates of monthly, yearly, and event-based climatic parameters.

PRISM data was selected for this analysis because it is an interpolation system that incorporates elevation fluctuation into the regression equations that are used to predict the gridded variation of each climate parameter. This winter weather risk assessment uses

monthly normal precipitation, mean annual days with snowfall greater than 1 inch, and mean monthly snowfall PRISM data to develop snow and ice potential maps for the state. These datasets have been generated to incorporate topographic effects on precipitation, capture orographic rain shadows, and include coastal and lake effect influences on precipitation and snowfall. The monthly precipitation grid provides a 30-year climatological average of total precipitation in inches. The mean monthly snowfall grid provides a 30-year climatological average depth of freshly fallen snow in inches. The mean annual days map reveals the 30-year average of the number of days that a location will receive greater than 1 inch of snowfall in a 24 hour period in a given year.

A criterion of greater than 1 inch was selected for winter snowfall severity assessment because this depth will result in complete road coverage that can create extremely dangerous driving conditions and will require snow removal by the local community. This amount of snowfall in a 24 hour period can also lead to business closure and school delays or cancellation. Figure 8 shows the average number of days with snowfall greater than one inch for the state and Figure 9 shows the same for the Central Shenandoah PDC region. The average number of days with snowfall increases dramatically in the Shenandoah, Allegheny and Blue Ridge mountain ranges bordering the counties of Highland, Bath, Augusta and a small portion Rockingham.

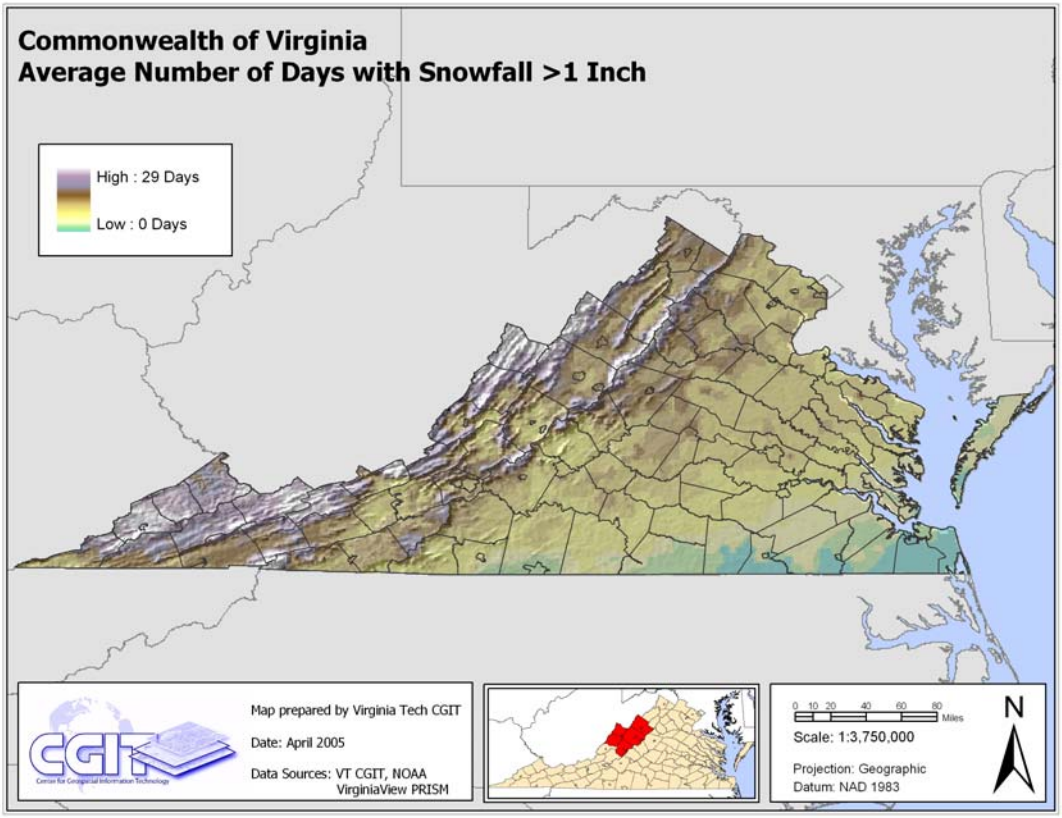

Figure 8. Virginia Average Number of Days with Snowfall > 1 inch.

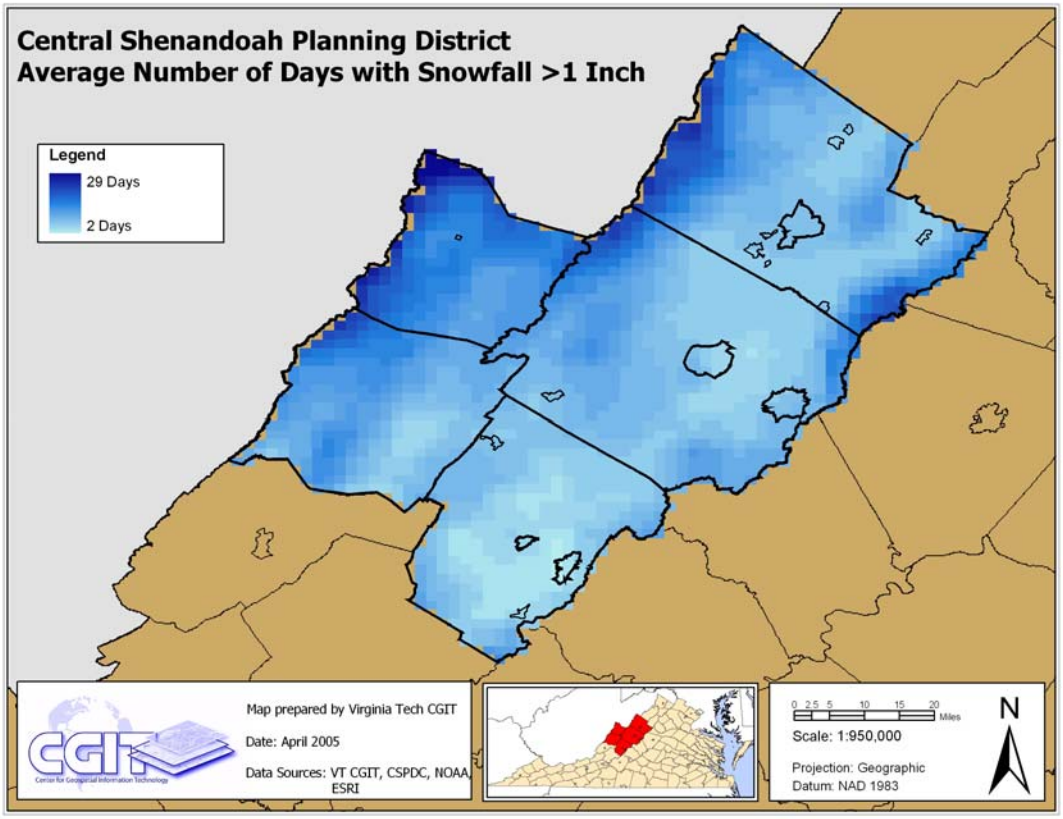

Figure 9. NNPDC Average Number of Days with Snowfall > 1 inch.

Ice Potential

Another challenge with winter weather in Virginia and the Central Shenandoah Planning District region is the amount of ice that often comes as part of winter weather. Snowfall and ice potential are generated based on the percentage difference between the total precipitation from November to April and the corresponding liquid equivalent snowfall depth. Since snowfall is in a frozen state, it does not accumulate on the surface the same way that liquid rainfall would, in order to account for this difference, there are characteristic snow/rain relationships that have been created. For example a value of 1 would mean that all of the precipitation at the location falls as liquid rainfall, and a value of 0.5 would mean that half of the precipitation falls as liquid rainfall and half falls as frozen precipitation. It is assumed that the lower the percentage, the greater potential that precipitation within these months is falling as snow. The values in the middle of the two extremes would represent regions that favor ice conditions over rain and snow. A five quantile distribution was applied to the output statewide grid to split the percentages into five characteristic climatological winter weather categories (snow, snow/ice, ice, rain/ice, and rain). Figure 10 shows the statewide map and Figure 11 show the Central Shenandoah PDC regional map. Rockbridge County and parts of Bath and Rockingham counties receive a mixture of the different types of winter weather.

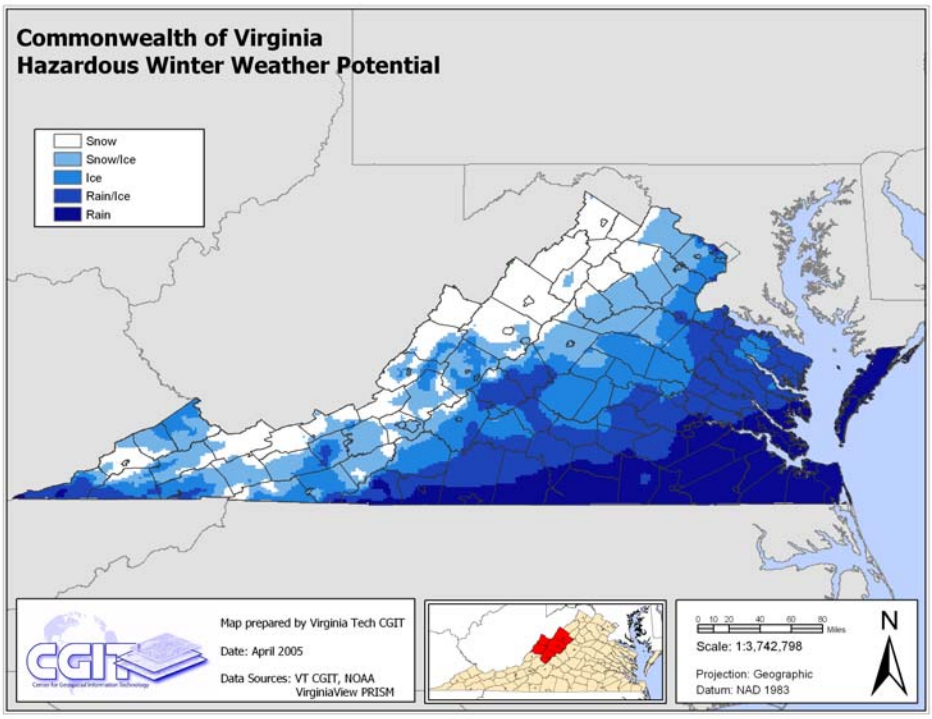

Figure 10. Virginia Hazardous Winter Weather Potential Based on LEQ Precipitation.

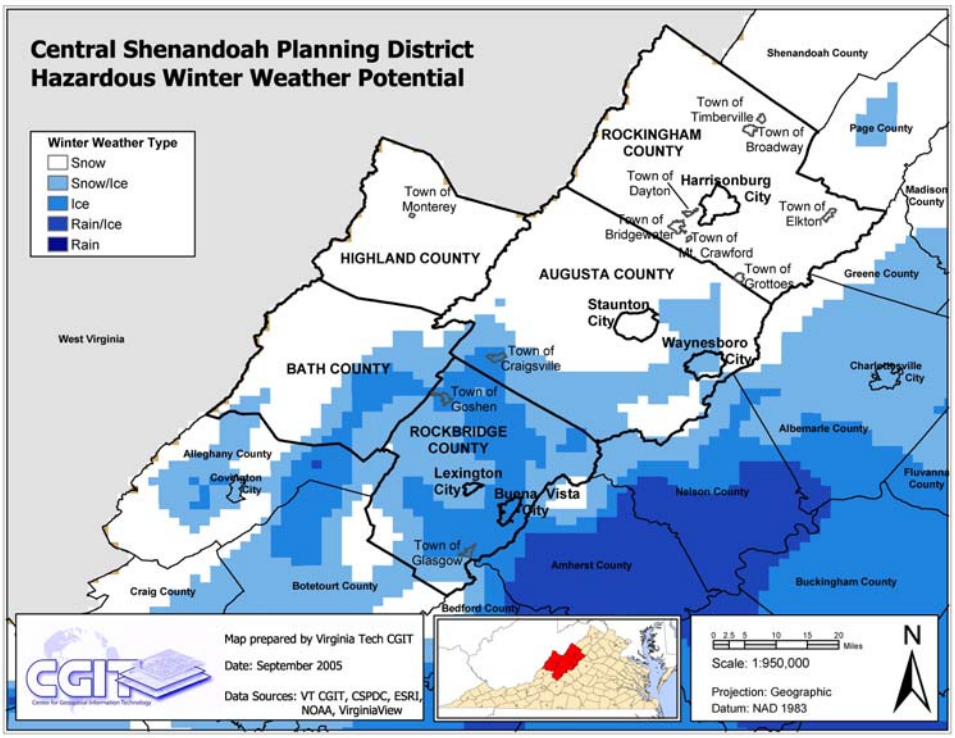

Figure 11. Central Shenandoah PDC Hazardous Winter Weather Potential Based on LEQ Precipitation.

Vulnerability Analysis

Figures 9 and 11 show the relative overall winter weather and ice potential for the Central Shenandoah region. Figure 12 and 13 show relative risk or vulnerability based these previous maps. These were developed by assigning a high risk to those census blocks within the regions with the greatest potential for snowy days (> 1 in of snow) or ice. Division into high, medium and low were based on the levels predicted from potential maps. Tables 20 and 21 show the population in each county impacted by the overall snowfall and ice risks. Highland County has the highest relative snowfall risk, followed by Rockingham County. Rockbridge County has the highest relative ice potential for the region. Future revision of this plan will need to develop a method to calculate the potential loss from these winter storms. Note tables 20 and 21 indicate the town populations impacted; the county totals include the populations of the towns. Future revision of this plan will need to develop a method to calculate the potential loss from these winter storms.

Appendices B2 and B3 contain the zoom-in maps for relative snowfall potential and relative ice potential for each of the localities in the region. The Appendix contains a full size map for the region, followed by the subsequent locality maps. These maps were consulted during the mitigation action development for potential sites of future actions.

Relative snowfall risk (Figure 12 and Appendix B2) illustrates Highland County and the Town of Monterey with the highest relative potential for snow, followed by a band of medium snow potential in the Counties of Rockingham, Augusta and Bath and in the Town of Craigsville. The southeast portion of the county has a relatively low potential for snow, with the exception being the eastern portion of Rockingham County and the Town of Grottoes.

Relative ice risk (Figure 13 and Appendix B3) characterizes the region as low and medium potential for receiving ice as the dominant type of winter weather. Areas with medium potential for ice are clustered around Rockbridge and Augusta Counties, including the cities of Lexington, Waynesboro and Buena Vista and the Towns of Goshen and Glasgow.

The winter weather mapping resolution does not support town based analysis, since most towns in Region 2000 would be represented by one or two pixels at this resolution. As weather data has better spatial resolution in the future, the ability to create practical town based analysis will be improved. While Tables 20 and 21 show town based vulnerability, the analysis method was designed to derive broad regional vulnerability comparisons, not pinpoint location comparisons. Also, the nature of winter storm preparedness and impact can not be represented with snow or ice potential maps.

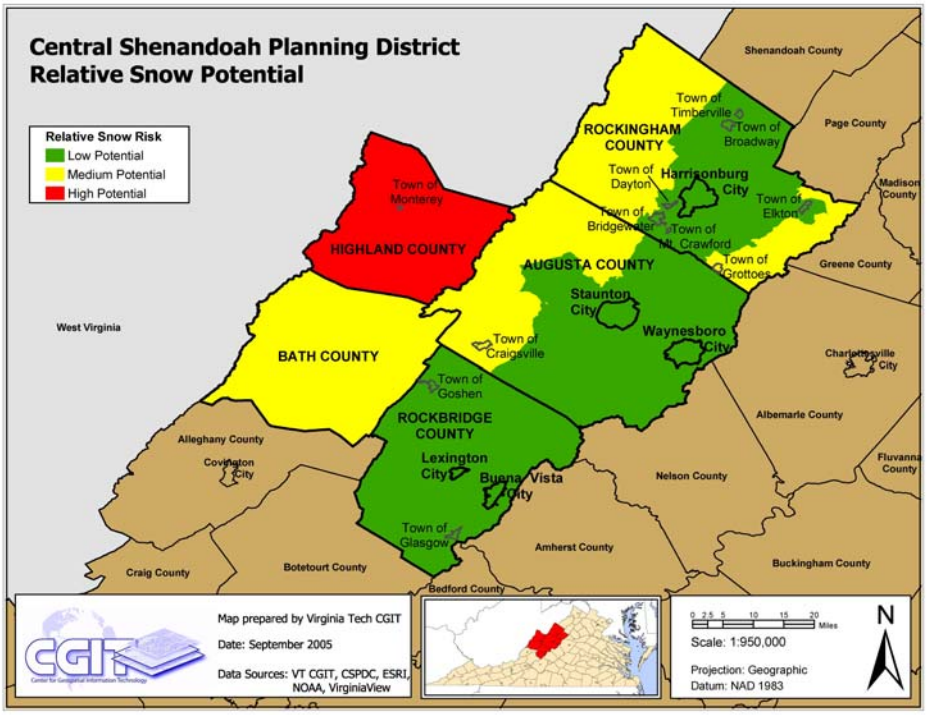

Figure 12. Central Shenandoah PDC Snowfall Relative Risk.

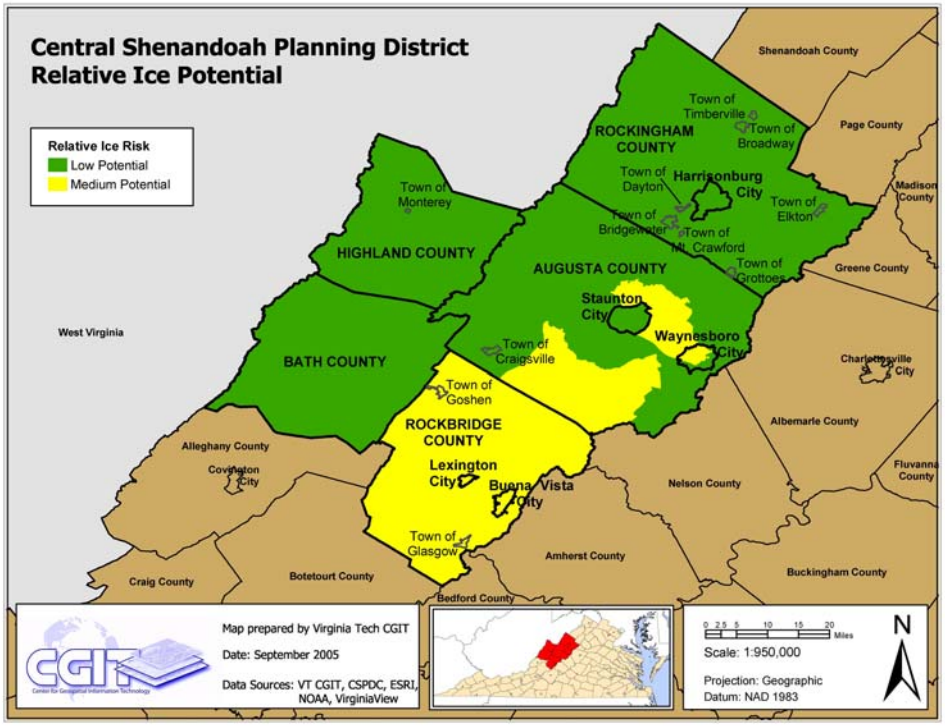

Figure 13. Central Shenandoah PDC Ice Relative Risk.

Table 20
Central Shenandoah PDC Population Snowfall Relative Risk

Community	Low	Medium	High
Augusta County	61,222	7,781	0
**Craigsville, Town of*	*0*	*812*	*0*
Bath County	0	5,083	0
Buena Vista City	6,305	0	0
Harrisonburg City	43,104	0	0
Highland County	0	0	2,566
**Monterey, Town of*	*0*	*0*	*222*
Lexington City	6,830	0	0
Rockbridge County	21,732	0	0
**Glasgow, Town of*	*1,140*	*0*	*0*
**Goshen, Town of*	*366*	*0*	*0*
Rockingham County	50,999	18,844	0
**Bridgewater, Town of*	*3,918*	*0*	*0*
**Broadway, Town of*	*1,209*	*0*	*0*
**Dayton, Town of*	*921*	*0*	*0*
**Elkton, Town of*	*1,935*	*0*	*0*
**Grottoes, Town of*	*0*	*1,455*	*0*
**Mt. Crawford, Town of*	*228*	*0*	*0*
**Timberville, Town of*	*1,596*	*0*	*0*
Staunton City	23,519	0	0
Waynesboro City	20,120	0	0
Total	**233,831**	**31,708**	**2,566**

*Denotes town values that are also included in totals for the perspective County.

Table 21
Central Shenandoah PDC Population Ice Relative Risk

Community	Low	Medium	High
Augusta County	61,222	7,781	0
**Craigsville, Town of*	*812*	*0*	*0*
Bath County	5,083	0	0
Buena Vista City	0	6,305	0
Harrisonburg City	43,104	0	0
Highland County	2,566	0	0
**Monterey, Town of*	*222*	*0*	*0*
Lexington City	0	6,830	0
Rockbridge County	0	21,732	0
**Glasgow, Town of*	*0*	*1,140*	*0*
**Goshen, Town of*	*0*	*366*	*0*
Rockingham County	69,843	0	0
**Bridgewater, Town of*	*3,918*	*0*	*0*
**Broadway, Town of*	*1,209*	*0*	*0*
**Dayton, Town of*	*921*	*0*	*0*
**Elkton, Town of*	*1,935*	*0*	*0*
**Grottoes, Town of*	*1,455*	*0*	*0*
**Mt. Crawford, Town of*	*228*	*0*	*0*
**Timberville, Town of*	*1,596*	*0*	*0*
Staunton City	23,519	0	0
Waynesboro City	4,952	15,1680	0
Total	**188,450**	**79,655**	**0**

*Denotes town values that are also included in totals for the perspective County.

7 – Land Subsidence & Karst (Medium Ranking)

Hazard History

Because sinkholes caused by karst are very site-specific and often occur in undeveloped areas, there is no existing long-term record for our region or for Virginia. Although, during the past 30 years, in VDOT's Staunton district that covers the Shenandoah Valley, with Harrisonburg at its center, 350 sinkholes have threatened roads in the district. However, in recent years there have been a number of sinkholes reported on Interstate 81 which runs through our region along a karst line. Over a two year period there were 6 sinkholes on I-81 and secondary roads in our region costing VDOT an average of $15,000 per event to repair. A few other recent occurrences are included in Table 22.

Table 22
Central Shenandoah PDC Karst and Land Subsidence Hazard Histories

Date	Damages
August 11, 1910	**Staunton:** Three sinkholes opened up on Lewis and Baldwin Street and Central Avenue. One of the sinkholes was so large that it swallowed a 35-foot maple tree and a house. Parts of other houses also fell into the sinkhole, and one worker was killed when he fell into one of the chasms caused by the sinkhole as it was being repaired.
Spring, 2000	Thirty-two sinkholes were reported after 7" of rain fell in April after a long dry spell. **Staunton:** Sixteen landslides occurred along Staunton District roads.
March, 2001	**Augusta County:** Interstate 81 was closed for a nine-mile stretch due to the sudden appearance of three sinkholes. The largest sinkhole measured 20 feet long, 11 feet wide and 22 feet deep, costing over $100,000 to repair.
October 28, 2001	**Staunton:** A 45-feet deep sinkhole opened up in downtown Staunton on Lewis Street.

Hazard Profile

Karst topography can be described as a landscape formed over limestone, dolomite, or gypsum, and characterized by sinkholes, caves, and underground drainage. Because of our mountainous terrain, much of our region is karst and characterized by the presence of sinkholes, sinking streams, springs, caves and solution valleys.

Occasionally the land surface in karst regions may collapse creating sinkholes. Sinkholes are classified as natural depressions of the land surface and caused when the acidic groundwater dissolves the surrounding geology. Most of these events are triggered by man's activities in the karst environment. Excessive pumping of groundwater from karst aquifers may rapidly lower the water table and cause a sudden loss of buoyant forces that stabilize the roofs of cavernous openings. Man-induced changes in surface water flow and infiltration also may cause collapse. Most sinkholes that form suddenly occur where soil that overlies bedrock collapses into the pre-existing void. Sinkholes can cause damage to

bridges, roads, railroads, storm drains, sanitary sewers, canals, levees, private and public buildings. Another problem associated with karst topography is its impact on the aquifers and groundwater contamination. The greatest impact is where polluted surface waters enter karst aquifers. This problem is universal among all karst that underlie populated areas. The groundwater problems associated with karst are accelerated with the advent of (1) expanding urbanization, (2) misuse and improper disposal of environmentally hazardous chemicals, (3) shortage of suitable repositories for toxic waste (both household and industrial), and (4) ineffective public education on waste disposal and the sensitivity of the karstic groundwater system.

Hazard Areas

A majority of the karst regions in Virginia follow Interstate 81, as seen in Figure 14, running northeast to southwest through Augusta County, Harrisonburg City, Rockingham County, Staunton and Waynesboro Cities and Rockbridge County. Figure 14 denotes the locations in the planning district that are more susceptible to karst hazards. These areas are broadly defined and mapped with a general understanding of karst hazard risks. A more detailed study would be required to determine the actual vulnerable structures at individual sites within these risk areas.

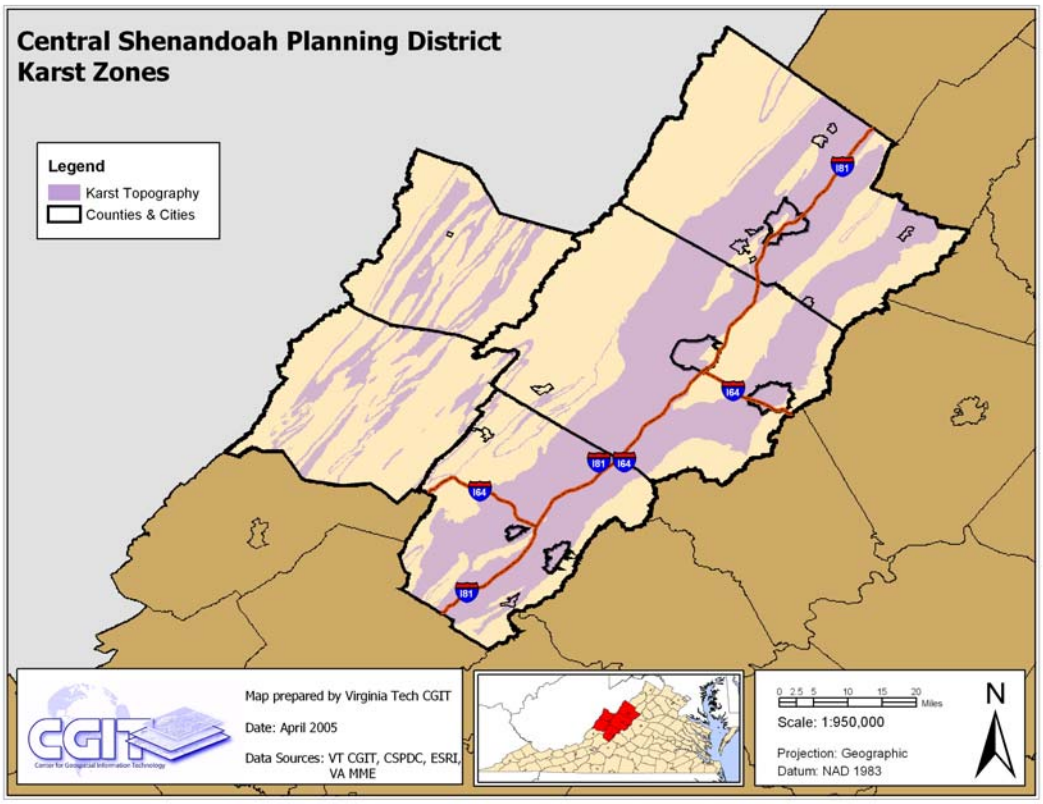

Figure 14. Central Shenandoah PDC Karst Zones (VA DMME).

Vulnerability Analysis

Table 23 illustrates the number of critical facilities and populations in the mapped karst zones. Augusta County (32%) and Staunton City (16%) have the largest amount of critical facilities in karst zones, while Rockingham County (31%), Augusta County (22%) and Harrisonburg City (21%) have the largest amount of the total population in karst zones.

Table 23
Central Shenandoah PDC Population and Critical Facilities near mapped Karst Zones

Community	Population in Karst Zones	Critical Facilities near Karst Zones
Augusta County	39,276	163
Bath County	3,922	9
Buena Vista City	2,873	20
Harrisonburg City	38,582	28
Highland County	956	14
Lexington City	3,496	26
Rockbridge County	11,702	55
Rockingham County	56,031	53
Staunton City	14,996	81
Waynesboro City	10,421	65
Total	**182,255**	**514**

Section 8 - Tornado (Medium Ranking)

Hazard History

Throughout its history, the Central Shenandoah Region has experienced several tornadoes. While not as common as flooding or winter storms, tornadoes have caused fatalities, personal injuries, and property damage in the Region. Tornadoes that have struck this area range from F0 (Weak, with 40-72 mph winds) to F2 (Strong with 113-157 mph winds) and are usually associated with severe thunderstorms. Table 24 details major tornado events in the CSPDC.

Table 24
Tornado Hazard History

Date	Location	Magnitude	Description	Interesting Facts
June 4, 1834	Rockbridge Co.	N/A	Wind/hail most destructive to residents within their memory. Damage path 18 miles long and 16 miles wide.	
June 4, 1911	Staunton & Augusta Co. (Possibly started in Mt. Solon area, blew s. east to Staunton where it zigzagged north and east also hit Greenville, Fishersville, and Verona from Augusta it crossed into Nelson and Amherst Cos.)	N/A	Damage path was 30 miles long and 7 miles wide – shaped like an hour glass. Hail ranged in size from marbles to goose eggs. Windows broken. People were injured but no fatalities. Water damage to houses. Roofs blown off. Barns destroyed. Crops damaged. Many people caught outdoors on Sunday afternoon outings. Staunton property loss $25,000 - $50,000. County crop loss $1 million. Turkeys/ chickens killed at farms. Boy Scouts helped clean up damaged houses. Four carloads of glass were sold to replace broken windows in Staunton.	"A handsome Persian cat belonging to Miss Florence Parrent was struck by lightning, and its tail hairs singed. Tabby was badly scared but not badly hurt" - Staunton News Leader 6/5/1911 Cover page
September 22, 1921	Augusta Co. (1 mi w. of Mint Springs – moved to Barterbrook)	F2	Damage path 5 miles long and 100 yards wide. Damage amounts not known. No reports of fatalities. Mother and child were severely injured when their home was destroyed and scattered ½ a mile.	
May 2, 1929 "Virginia's Deadliest Tornado Outbreak"	Bath Co.	N/A	Bath County in Cowpasture Valley. Valley at an elevation of 1500 feet. 10 people were injured but no one was killed. Trees damaged, roof blown off, barns destroyed, 2 people injured in Bath Co. 2 schools damaged here but students had been released. Several homes and a church at Nimrod Hall destroyed.	Storm swept across 12 states from Florida to Missouri to VA more than 200 injured and approx. 40 killed in U.S. (22 in VA).

Date	Location	Magnitude	Description	Interesting Facts
			Weather turned cold and snow fell after the storm. "In some places, where a house, a barn, a garage or other building stood, there is only a bare spot to indicate where a structure stood, not even a splinter of the building being left." – Lexington News-Gazette 5/7/1929	Five tornadoes in VA that day. 22 people killed and over 150 injured. $1/2 million in damages. 4 schools destroyed including one school at Rye Cove in Scott County where 12 children and 1 teacher were killed and 42 injured.
April 5, 1952 (2 tornadoes that day)	Augusta Co. & Rockingham Co.	F2	Augusta Co. tornado tracked 1 mile and had a damage path 150 yards wide. No fatalities and 2 people injured. Rockingham: Damage path 4.9 miles long and 100 yards wide. No damage amounts known.	
April 28, 1959	Highland Co.	F1	Damage path and extent not known.	
July 1, 1959	Augusta Co.	F1	Tracked 11.3 miles with a damage path of 100 yards. No fatalities or injuries. Damage amounts unknown.	
August 6, 1960	Rockingham Co.	F2	Damage path and amounts are unknown. There were no injuries.	
November 29, 1963	Augusta Co.	F2	Damage path was one mile long – width not known. No fatalities or injuries. A house under construction was leveled and the roof came off another house. Damage estimated at $50,000.	
April 4, 1974 "Super Outbreak"	Augusta Co., Staunton City, Bath Co., Highland Co.* *possible touchdown in Big Valley area.	F2 in Augusta	In Augusta Co., tornado struck near Westview, moved n. east to Weyers Cave. Damage path was 18 miles long and 200 yards wide. Blew over 90 barns, destroyed 2 homes, damaged 4 homes, outbuildings and a school. Verona area hit hard. Ft. Defiance High School lost part of the roof. Augusta Co. damage - $1 million. Roof damage to Staunton City Hall. In Bath Co., Bacova	These tornadoes were the last of the Super Outbreak which totaled 148 tornadoes over 2 days. Most of the tornadoes were recorded in a 24 hour period. Outbreak affected

Date	Location	Magnitude	Description	Interesting Facts
			Junction and Millboro were affected. Millboro – roofs blown off, windows broken, barns damaged.	13 states. The average path length of the tornadoes was 18.7 miles. Six of the tornadoes were F5s. 330 people died in the U.S. 2 deaths in VA. 19 counties in VA were hit with thunderstorms or tornadoes.
June 5, 1975	Augusta Co. & Rockbridge Co.	F0	Tornado struck near Lyndhurst. The weak tornado tracked .2 miles with a damage path of 30 yards wide. Destroyed a small building and 25-30 trees. Damage estimated at $2,000. No deaths or injuries. Tornado struck near Collierstown – damaged trees and fences. Damage estimated at $1,000.	
August 15, 1975	Rockingham Co.	F1	Tornado struck Melrose area which is 6 miles NW of Harrisonburg. Damage path 1 mile long and 30 yards wide. No injuries. Tornado overturned a trailer, ripped off a roof, and carried away outbuildings. Damages $15,000.	
October 2, 1979	Town of Dayton	F1	Damage path 1.1 miles long and 35 yards wide. No injuries. Snapped off tree tops and utility poles, broke windows. Flipped an unoccupied trailer. Damages $20,000.	
May 4, 1990	Augusta Co.	F2	Damage track was 7 miles long and 80 yards wide. Hit Augusta Springs and Swoope. Tornado tracked a mile through community of Augusta Springs. Lifted 2500 feet over mountains and set back down again on other side. 2 people killed in mobile home in Swoope. 3 injured in Swoope and 7 injured in Augusta Springs.	The tornado formed in a thunderstorm along a warm front well out ahead of the expected threat area.
June 10, 1995	Waynesboro and Augusta Co.	(Strong F2) F1 – F2	Touched down on west side of Waynesboro. Tracked 3.5 miles through the County and southwest portion of the City. Damage path averaged 200 yards wide. No deaths or injuries. Hit industrial area,	Tornado flipped a 22.5 ton crane.

Date	Location	Magnitude	Description	Interesting Facts
			peeling off roofs and damaging 15-20 homes. Damages = $2 million.	
June 24, 1996	Town of Broadway	F1	Damage path was .5 miles long and 100 yards wide. No injuries. Tornado tore roofs off 2 homes and 2 poultry houses. Damaged trees. Damage estimates $40,000.	
July 11, 1999	Rockingham Co. & Harrisonburg	F0	Damage path was .1 mile long and 15 yards wide. No injuries. Damage to a store's tin roof and shingles on a home. Damages estimated at more than $2,000.	
July 31, 1999	Augusta Co.	F1 (Small land spout or tornado)	Struck 5 miles east of Staunton. Damage path .1 mile long and 100 yards wide. Destroyed a barn, damaged a greenhouse, and took down trees. No injuries. Damage estimates: $25,000.	

Hazard Profile

Damaging winds typically are associated with tornadoes or landfalling hurricanes. Isolated "downburst" or "straight-line" winds associated with any common thunderstorm can also cause extensive property damage.

Tornadoes are classified as a rotating column of wind that extends between a thunderstorm cloud and the earth's surface. Winds are typically less than 100 mph, with severe tornado wind speeds exceeding 250 mph. The rotating column of air often resembles a funnel shaped cloud. The widths of tornados are usually several yards across, with infrequent events being over a mile wide. Tornadoes and their resultant damage can be classified into six categories using the Fujita Scale. This scale assigns numerical values for wind speeds inside the tornado according to the type of damage and degree of the tornado. Most tornadoes are F0 and F1, resulting in little widespread damage. Tornado activity normally spans from April through July but tornados can occur at any time throughout the year. In Virginia, peak tornado activity is in July. Hot, humid conditions stimulate the tornadoes growth.

Strong tornadoes may be produced by thunderstorms and often are associated with the passage of hurricanes. On average, about seven tornadoes are reported in Virginia each year. The total number may be higher as incidents may occur over areas with sparse populations, or may not cause any property damage.

Tornadoes also produce hail. Hailstorms are also outgrowths of severe thunderstorms. During summer months, when the difference between ground and upper level temperatures is significant, hail may develop. The size of the hailstones is directly related to the severity

and size of the storm. Hail is described as chunks of ice, often in a spherical or oblong shape, that are produced by thunderstorms. The size of the hail greatly affects the magnitude or severity of damage. Storms can produce hail from as small as ¼ inch in diameter to up to 4 ½ inches. Depending on the size of hail determines the potential damage.

Tornado damage is computed using the Fujita Scale, as shown in Table 25. Classification is based on the amount of damage caused by the tornado, where the measure of magnitude is based on the impact.

Table 25
Fujita Tornado Intensity Scale (From National Weather Service)

Classification	Max. Winds (mph)	Path Length (mi.)	Path Width (mi.)	Damage
F0	Less than 73	less than 1.0	less than 0.01	Chimneys damaged, trees broken
F1	73-112	1.0-3.1	0.01-0.03	Mobile homes moved off foundations or overturned
F2	113-157	3.2-9.9	0.03-0.09	Considerable damage, mobile homes demolished, trees uprooted
F3	158-206	31-10	0.10-0.29	Roof and walls torn down, trains overturned, cars thrown
F4	207-260	32-99	0.30-0.90	Well-constructed walls leveled
F5	261-318	100-315	1.0-3.1	Homes lifted off foundations and carried some distance, cars thrown as far as 300 ft

The classification of the tornado gives an approximate depiction of what the corresponding damage of the tornado will be. Because there are so few recorded tornados for the CSPDC, statewide tornado statistics provide some additional information on likely past occurrence breakdown by Fujita Scale and some indication of future occurrence. A majority of Virginia's tornadoes are F0 and F1 on the Fujita Scale, shown in Table 26, which result in minimal extensive damage.

Table 26
Virginia Tornado Statistics 1950-2001

Fujita Scale	Class.	MPH	Damage Description	# in VA	%	Deaths/ Injuries	Damages ($ Mil)
F0	Weak	40-72	Light damage. Tree branches snapped; antennas and signs damaged.	99	26	0 / 0	7
F1	Moderate	73-112	Moderate damage. Roofs off; trees snapped; trailers moved or overturned.	186	50	1/85	57
F2	Strong	113-157	Considerable damage. Weak structures and trailers demolished; cars blown off road.	66	18	3/72	75
F3	Severe	158-206	Roofs and some walls torn off well constructed buildings; some rural buildings demolished; cars lifted and tumbled.	23	6	19 / 102	140
F4	Devastating	207-260	Houses leveled leaving piles of debris; cars thrown some distance.	2	0.1	4 / 248	50
F5	Incredible	261-318	Well built houses lifted off foundation and disintegrated with debris carried some distance.	0	0	n/a	n/a

Figure 15 shows tornado occurrence in the Central Shenandoah PDC Region. Since tornadoes are so infrequent for the region, the Hurricane Wind analysis covers more probable high wind occurrences. Sixteen tornados have been recorded for the CSPDC region during 1950 through 2004. It is also interesting to note that there are no recorded tornados in the national forests and parks. This is a result of tornados only being recorded when impacts affect people or property. Some areas in the region appear to be slightly more prone to tornadoes than others. It is thought that this is caused by topographical influences on thunderstorms such as the change in low-level wind flow and humidity caused by the orientation of the mountains. One such area is the southern Shenandoah Valley near the cities of Staunton and Harrisonburg. It should be noted that areas with denser population are more likely to report a tornado than less populated areas.

While the tornadoes that have occurred in the Central Shenandoah Region do not compare to the numbers or strength of the tornadoes that have touched down in tornado alley in the Midwestern United States, they have caused large amounts of property damage, many personal injuries, and a few fatalities. The tornadoes that the Region does experience are most frequently spawned from thunderstorms and have little to no warning time. Tornadoes did affect the Central Shenandoah Region in two significant events, Virginia's Deadliest Tornado Outbreak in 1929 and the Super Outbreak of 1974. The potential for similar tornadoes in the future is certain.

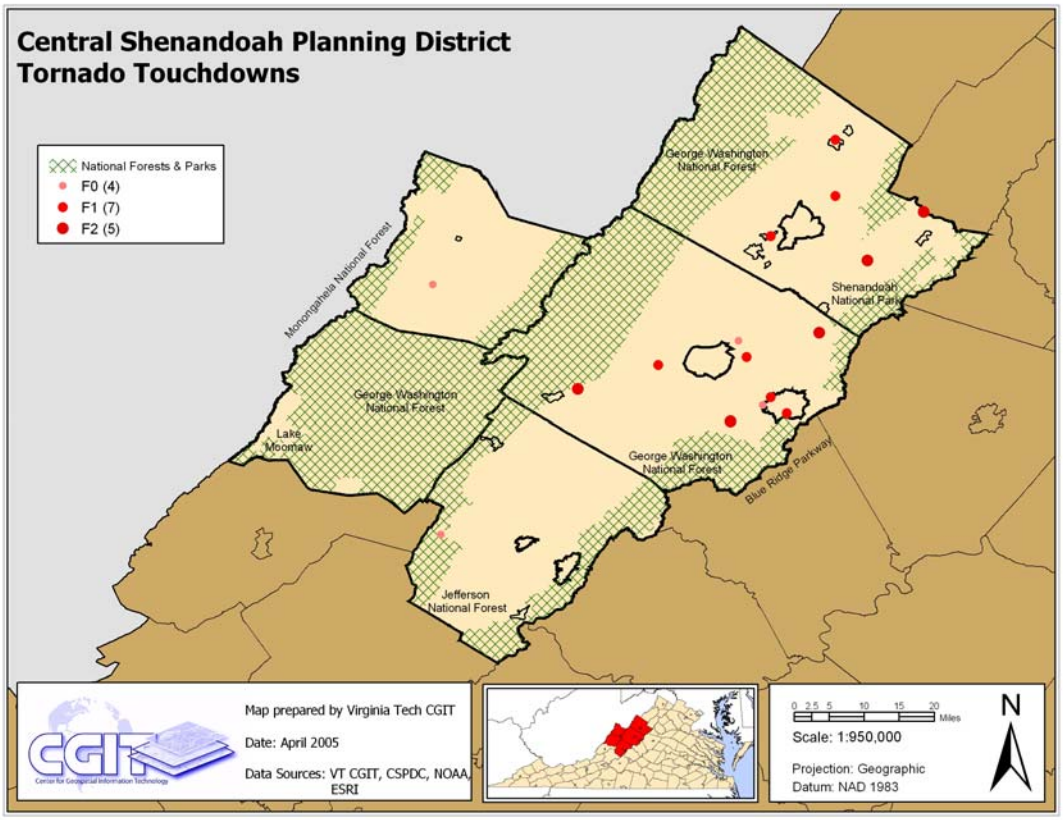

Figure 15. Central Shenandoah PDC Tornado Touchdowns.

9 - Wildfire (Medium Ranking)

Hazard History

The Virginia Department of Forestry (VDOF) website provided fire incidence data for fire years 1995-2001. The data provided by VDOF was summarized into the following tables.

Table 27 provides information on the number of wildfires per county. Table 28 is a summary of the number of acres and total damages of wildfires in the Central Shenandoah area. Note that the tables do not include data for towns or cities; this data was not available through VDOF. Table 29 illustrates the cause of fire, broken down by county. The data shows that 27% of fires were caused by debris, followed by 21% caused by incendiary devices and 21% caused under miscellaneous conditions.

Table 27
Wildfire Statistics by Fire Year 1995-2001 (from VDOF)

Number of Wildfires by Fire Year (1995-2001)								
County	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Total**
Augusta County	17	6	2	20	9	18	24	96
Bath County	5	2		4	6	3	6	26
Highland County	2	1	2	1	4	1	1	12
Rockbridge County	5	3	5	6	5	1	7	32
Rockingham County	36	20	17	18	40	13	76	220
Total	**65**	**32**	**26**	**49**	**64**	**36**	**114**	**386**

Table 28
Wildfire Summary 1995-2001 (from VDOF)

Fire Year	**1995**		**1996**		**1997**		**1998**	
County	**Total Acres**	**Total Damage**	**Total Acres**	**Total Damage**	**Total Acres**	**Total Damage**	**Total Acres**	**Total Damage**
Augusta County	61.3	$1,600	6.2	$2,500	2.5	$1,500	482.3	$206,275
Bath County	17	$4,100	3	$8,500	0	$0	17.3	$2,825
Highland County	29	$1,700	2	$500	2	$500	35	$7,000
Rockbridge County	4.9	$405	0.3	$20	481.1	$6,360	4.6	$170
Rockingham County	166.7	$75,560	8.3	$33,725	16.1	$100	24.4	$2,100
Total	**278.9**	**83365**	**19.8**	**45245**	**501.7**	**8460**	**563.6**	**218370**

Fire Year	1999		2000		2001		Acres Total	Damages Total
County	Total Acres	Total Damage	Total Acres	Total Damage	Total Acres	Total Damage		
Augusta County	113.2	$10,000	214.5	$35,700	355.8	$31,801	1235.8	**$289,376**
Bath County	53	$11,200	23	$23,500	93	$58,800	206.3	**$108,925**
Highland County	35.3	$4,000	0.3	$0	5	$500	108.6	**$14,200**
Rockbridge County	100.3	$5,150	2	$1,900	31	$112,950	624.2	**$126,955**
Rockingham County	151.6	$5,950	10	$0	147	$728,095	524.1	**$845,530**
Total	**453.4**	**36300**	**249.8**	**61100**	**631.8**	**$932,146**	**2699**	**$1,384,986**

Table 29 - Wildfire Causes 1995-2001 (from VDOF)

County	Lightning	Camp Fire	Smoking	Debris	Incendiary	Equip. Use	R&R	Child	Misc.	Total
Augusta County	2	3	14	25	17	4	5	3	23	**96**
Bath County	2	4	1	6	2	5		1	5	**26**
Highland County	5	1		2		1			3	**12**
Rockbridge County	5		3	10	1	1		2	10	**32**
Rockingham County	4	4	11	61	61	26	1	12	40	**220**
Total	**18**	**12**	**29**	**104**	**81**	**37**	**6**	**18**	**81**	**386**

Hazard Profile

A wildfire is an uncontrollable fire spreading through vegetative fuels, exposing and possibly consuming structures. They often begin unnoticed and spread quickly and are usually signaled by dense smoke that fills the area for miles around. Naturally occurring and non-native species of grasses, brush, and trees fuel wildfires. Wildfire behavior is based on three primary factors:

1. Fuel - The type, and amount of fuel, as well as its burning qualities and level of moisture affect wildfire potential. The continuity of fuels, expressed in both horizontal and vertical components is also a factor.

2. Topography – the topography is important because it affects the movement of air, fueling the fire over the ground surface. The slope and shape of terrain can change the rate of speed at which the fire travels. In general terms, the steeper the slope of the land, the faster a fire can spread up the slope.

3. Weather – the weather affects the probability of wildfires and has a significant effect on its behavior. Temperature, humidity and wind affect the severity and duration of wildfires. Areas that have experienced prolonged droughts or are excessively dry are also at risk for wildfires.

People start more than four out of every five wildfires, usually as debris burns, arson, or carelessness. Lightning strikes are the next leading cause of wildfires.

Hazard Areas

Figure 16 shows the wildfire hazard map developed by Virginia Department of Forestry (VDOF). In 2002 and 2003, VDOF examined which factors influence the occurrence and advancement of wildfires and how these factors could be represented in a GIS model. VDOF determined that historical fire incidents, land cover (fuels surrogate), topographic characteristics, population density, and distance to roads were critical variables in a wildfire risk analysis. The resulting high, medium, and low risk category reflect the results of this analysis. The large percentage of high risk areas are in national forests and parks. These areas of concern are managed and monitored by the department of forestry.

Vulnerability Analysis

Tables 30 and 31 illustrate the number of homes in woodland homes and communities, as designated by Virginia Department of Forestry. In the region, 71% of the woodland homes are considered to have high potential for a wildfire, while 63% of woodland communities in the planning area are considered at high risk for wildfire.

Table 30
Woodland Communities Wildfire Risk.

Number of Woodland Communities by Fire Rank					
County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	21	19	**40**	**48%**
Bath	0	4	4	**8**	**50%**
Highland	N/A	N/A	N/A	**N/A**	**N/A**
Rockbridge	1	6	9	**16**	**56%**
Rockingham		1	25	**26**	**96%**
Total	**1**	**32**	**57**	**90**	**63%**

Table 31
Woodland Homes Wildfire Risk

Number of Woodland Homes by Fire Rank					
County	Low Potential	Medium Potential	High Potential	Total	% High Risk
Augusta	0	493	580	**1,073**	**54%**
Bath	0	120	65	**185**	**35%**
Highland	0	20	10	**30**	**33%**
Rockbridge	300	82	458	**840**	**55%**
Rockingham	0	25	1,523	**1,548**	**98%**
Total	**300**	**761**	**2,636**	**3,697**	**71%**

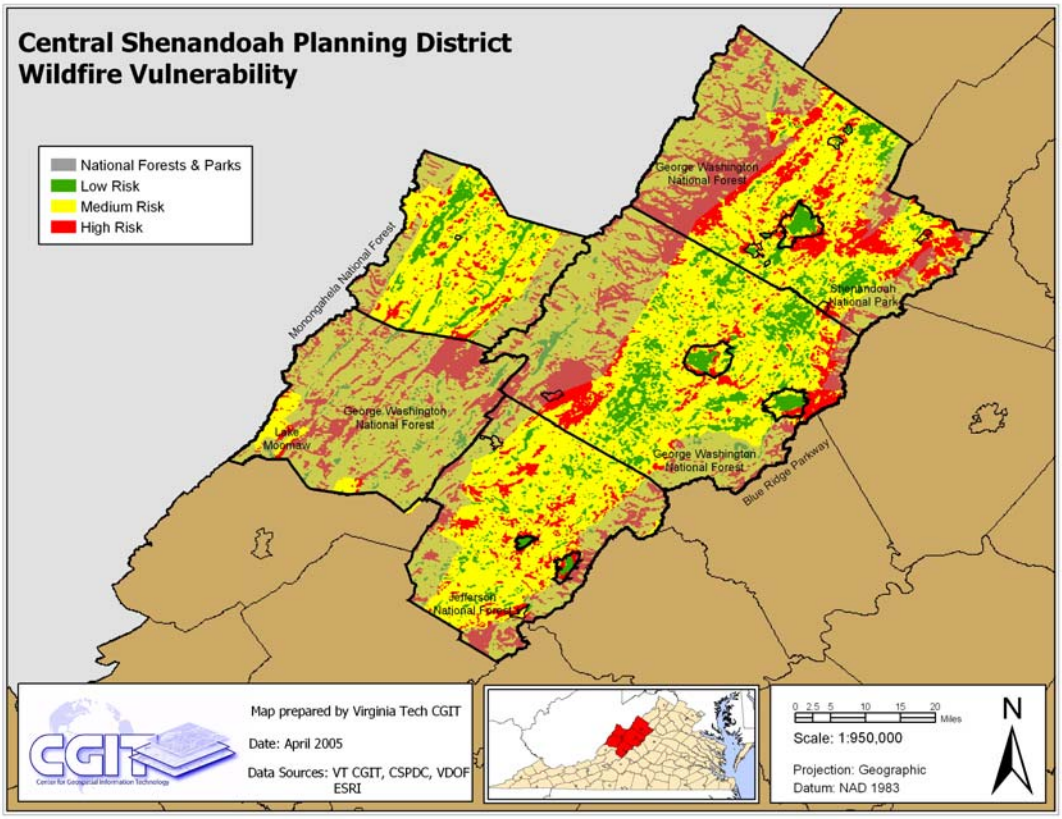

Figure 16. Wildfire Vulnerability (from VDOF)

Structures at Risk

Table 32 shows the percentages of critical facilities in fire risk zones. Approximately 9% of the region's critical facilities are located in a high risk area. Figure 17 shows the locations of critical facilities in relation to fire risk zones.

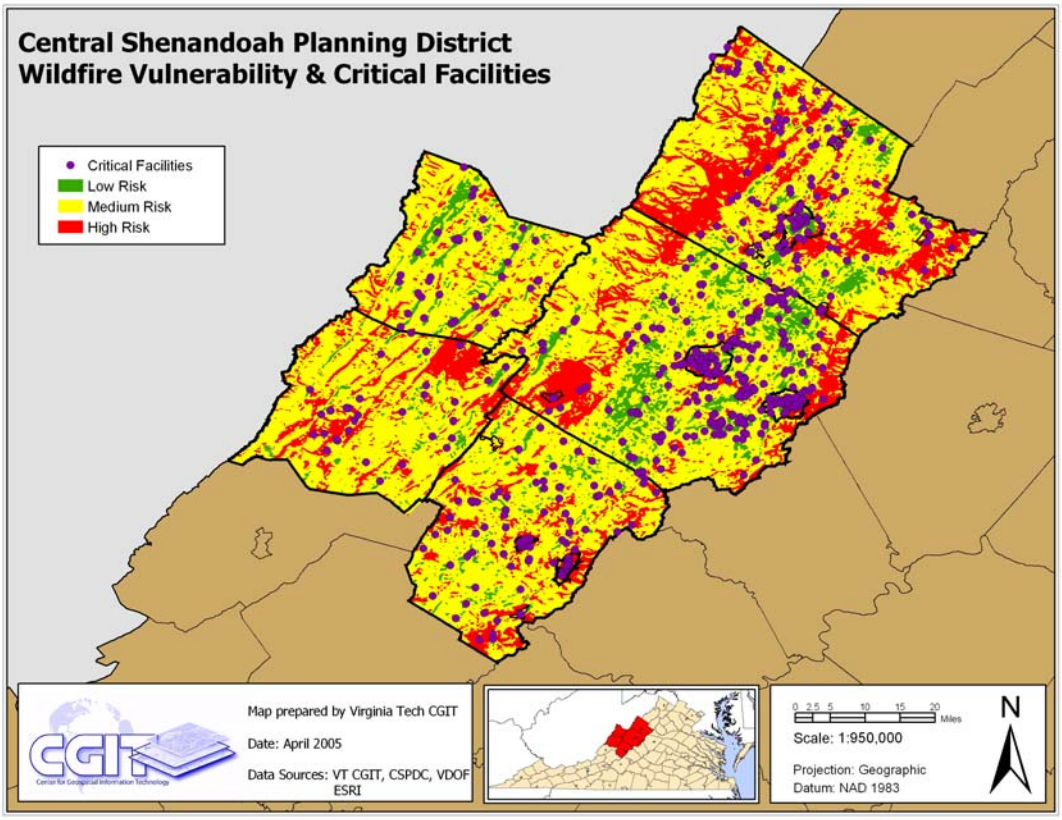

Figure 17. Wildfire Vulnerability and Critical Facilities (from VDOF)

Table 32
CSPD Critical Facilities Wildfire Vulnerability

Number of Critical Facilities by Fire Rank					
County	Low Potential	Medium Potential	High Potential	Grand Total	% High Risk
Augusta County	44	161	20	225	**9%**
Bath County	3	23	9	35	**26%**
Buena Vista City	20	0	0	20	**0%**
Harrisonburg City	33	5	3	41	**7%**
Highland County	16	17	4	37	**11%**
Lexington City	26	0	0	26	**0%**
Rockbridge County	2	64	8	74	**11%**
Rockingham County	10	67	15	92	**16%**
Staunton City	72	9	3	84	**4%**
Waynesboro City	59	7	1	67	**1%**
Total	**285**	**353**	**63**	**701**	**9%**

10 - Landslide (Low Ranking)

Hazard History

The best predicator of future landslides is past landslides in the same place. Figure 18 illustrates potential risk areas for the Commonwealth of Virginia. Additionally areas with steep slopes, poor drainage, and erosion have a greater probability of landslides. Developed hillsides and slopes denuded by wildfires can also lead to landslides. One area in our region where rock slides are common is Interstate 64 at Afton Mountain both in Nelson (outside region) and Augusta counties. Many thousands of dollars have been spent removing debris from the highway and installing barriers since the highway was constructed in the late 1960's. The worst landslide in and adjacent to our region occurred as a result of Hurricane Camille in 1969 where catastrophic debris flows were responsible for the deaths of more than 150 people in the Virginia Blue Ridge.

Hazard Profile

A landslide is a downward movement of a slope and materials under the force of gravity. Landslide occurs when masses of rock, earth or debris move down a slope. Some move slowly causing gradual damage, while others move rapidly destroying property unexpectedly. They are activated by rainstorms, snowmelts, earthquakes, fires, volcanoes and by human modification to the land such as mining and construction. They are common all over the United States and cause up to 2 billion dollars in damages and from 25 to 50 deaths annually. Common types of landslides include rock slides, slumps, mudslides, debris flows, avalanches, and earth flows. Types of landslides vary depending on the amount of water and type of materials that they carry. Landslides usually affect infrastructure such as roads and bridges, but they can also affect individual buildings and businesses, especially those located close to dangerous topographic features such as the top or bases of slopes or in valleys.

Landslides occur in every state and U. S. territory and are common throughout the Appalachian region, particularly where there are steep slopes, clay-rich soils, periodic heavy rains and vegetation loss caused by wildfires. A debris flow event can be expected to occur somewhere in the southern Appalachian Mountains on the order of once every 3 years.

Several natural and human factors may contribute to or influence landslides. How these factors interrelate is important in understanding the hazard. The three principal natural factors are topography, geology, and precipitation. The principle human activities are cut-and-fill construction for highways, construction of buildings and railroads, and mining operations.

The USGS recognizes four major impacts caused by land subsidence:

- changes in elevation and slope of streams, canals, and drains
- damage to bridges, roads, railroads, storm drains, sanitary sewers, canals, and levees
- damage to private and public buildings
- failure of well casings from forces generated by compaction of fine-grained materials in aquifer systems

Landslides can cause serious damage to highways, buildings, homes, and other structures that support a wide range of economies and activities. Landslides commonly coincide with other natural disasters. Expansion of urban development contributes to greater risk of damage by landslides.

Hazard Areas

According to the landslide susceptibly and incidence map (Figure 18) Augusta and Rockingham Counties have the highest susceptibility and incidence risk in the region. The remaining areas are characterized as areas of high incidence. These areas are broadly defined and mapped with a general understanding of landslide hazard risks. A more detailed study would be required to determine the actual vulnerable structures at individual sites within these risk areas.

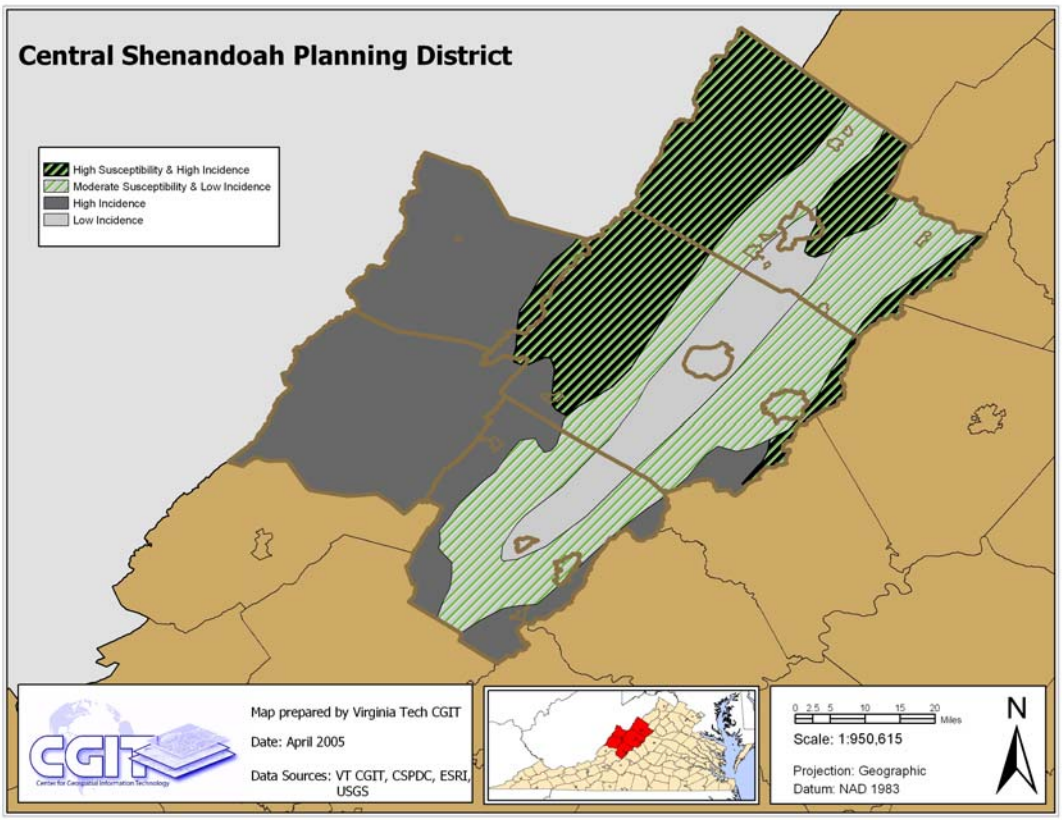

Figure 18. USGS Landslide Susceptibility and Incidence.

11 - Terrorism (Low Ranking)

Hazard History

Terrorism is not required to be included in the CSPDC Hazard Mitigation Plan according to current Interim Final Rule (44 CFR Parts 201 and 206). Currently there is no universal definition for terrorism. Terror can be exhibited through many different forms. The code of Federal Regulations defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives." No terrorism history was available for the region at this time. Emergency Operation Plans (EOP) for this region may contain information on this hazard. These plans are beginning to address terrorism as a concern in operation.

The FEMA risk management series on mitigating potential terrorist attacks against buildings provides information on developing a realistic prioritization of human-caused hazards. The mitigation strategies section on this report should provide projects to address human caused hazard vulnerability. Future concepts to consider include:

I. Communities determine the relative importance of various critical and non-critical facilities and the asset of these systems
II. Determine the vulnerability to the specified hazard
III. Determine what threats are known to exist in the communities

One terrorism concern for this region relates to possible evacuations of the Northern Virginia/Washington D.C metro area due to possible terrorism threats. Researchers from James Madison University in Harrisonburg at the Institute for Infrastructure and Information Assurance have conducted some preliminary studies to determine the possible number of displaced residents that may need to be temporarily housed in the region, and the impact as a result of the increased traffic flow on Interstates 64 and 81. In future hazard plans for the Central Shenandoah region, terrorism issues related to Northern Virginia and other adjacent regions will require more extensive intra-regional planning and cooperation.

Hazard Profile

Currently there is no universal definition for terrorism. Terror can be exhibited through many different forms. The code of Federal Regulations defines terrorism as "the unlawful use of force and violence against persons or property to intimidate or coerce a government, civilian population, or any segment thereof, in furtherance of political or social objectives."

Hazard Areas

Local Emergency Operation Plans are beginning to address terrorism concerns with special appendices with limited access for only local government staff. Consult these plans for further information.

Vulnerability Analysis

Vulnerability analysis, when available, has been conducted by the different localities. This information has been addressed in local Emergency Operation Plans.

V. MITIGATION ACTIONS, STRATEGIES AND PROJECTS

We know that we cannot prevent disasters from occurring, but through proactive planning and mitigation activities we can reduce the impact of these disasters. The following section describes six broadly effective mitigation categories (prevention, property protection, natural resource protection, emergency services, structural projects, and public information) as well as examples and strategies for each. Using the findings from the risk assessment, numerous meetings, workshops, and exercises the committee developed the following mitigation strategies for each of the hazards identified in the plan. Hazards that ranked low (landslides, earthquake, and terrorism) were not addressed in the mitigation strategy section.

The six categories of mitigation include:

1. Prevention - activities that keep problems from getting worse. The use and development of vulnerable areas is limited through planning, land acquisition or regulations. They are usually administered by building, zoning, planning, and/or code enforcement offices. Examples include storm water and floodplain management, planning and zoning, and code enforcement.

2. Property Protection - activities intended to mitigate damage primarily on private structures on a building-by-building or parcel basis. Examples include flood proofing, elevation, acquisition and relocation of structures as well as flood insurance coverage.

3. Natural Resource Protection - activities that preserve or restore natural areas or the natural function of disaster-prone areas particularly floodplains and watershed areas. They are usually implemented by parks, recreation or conservation agencies or organizations. Examples include wetlands protection and open space preservation.

4. Emergency Services - measures that are taken during a disaster to minimize its impact. These measures are the responsibility of city or county emergency management staff and the owners or operators of major or critical facilities. Examples include flood warning systems and critical facilities protection.

5. Structural Projects – projects that keep disasters away from an area with a structural, mechanical or other control measures. They are usually designed by engineers and managed or maintained by public works staff. Examples include levees and floodwalls and stream remediation.

6. Public Education and Awareness – activities that advise and educate citizens and business owners about hazards, ways to protect people and property from hazards through disaster preparedness and mitigation education. They are usually implemented by a public information office. Examples include public awareness programs, environmental education, and map modernization projects.

Action 1: Improve local government planning, zoning, land use regulations and code enforcement to reduce impact of natural disasters.

Hazard: All Hazards
Location: Region-wide
Category: Prevention

Action Statement: Perhaps the most cost-effective way to reduce damages due to natural hazards is to incorporate mitigation measures into planning, zoning ordinances, land use regulations, and code enforcement as described in the strategies below. Most of the hazards that impact our region can be reduced by addressing them upfront in planning and prevention and through code enforcement and regulatory activities.

Strategies

1.1 For flood hazards, strengthen current floodplain, zoning and site development ordinances by adopting higher standards that provide additional protection and limit or restrict further development in the floodplain, i.e. additional freeboard, flood protection setbacks, limitation on fill, minimization of hydrostatic pressure, protection for mechanical and utility systems, etc. For drought hazards, utilize growth management tools like zoning and land use regulations to encourage low-impact development and forest preservation. For land subsidence hazards, strengthen enforcement of land use, zoning regulations and building ordinances that regulate construction in areas susceptible to landslides and sinkholes i.e. steep slopes, intermittent stream channels, and karst topography.

1.2 Provide funds for water supply planning and ground water protection projects and seek and research alternative water supplies for communities. Improve forecasting and monitoring of drought conditions.

1.3 Ensure that floodplain ordinances and building codes are clearly understood by staff, property owners, developers, bankers and insurance companies.

1.4 Implement zoning tools that steer development away from hazardous areas or natural areas deserving preservation. Include Department of Forestry personnel in subdivision review for new development in woodland-urban interface areas.

1.5 Provide for tax incentives, donated easements, and other approaches that can assist in preserving land in the floodplain and other environmentally sensitive areas for agricultural, environmental, recreational or educational uses.

1.6 Rezone to open space or acquire undeveloped portions of floodplain to prohibit future residential building.

1.7 Limit government expenditures for public infrastructure such as roads and water and sewer service in hazard-prone areas.

1.8 Provide necessary staff and staff training to enforce floodplain regulations and building codes.

1.9 Provide training and appropriate equipment/tools for local fire fighters to respond to woodland fires.

1.10 Sponsor workshops for Building Officials that focus on floodplain ordinances and FEMA regulations.

Action 2: Promote the Community Rating System (CRS).

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Action Statement: The National Flood Insurance Program (NFIP) administers a program called the Community Rating System (CRS) whereby the cost of flood insurance is reduced in those jurisdictions which carry out floodplain management activities which are more protective than the minimum requirements of the NFIP. Examples include public outreach, mapping and regulations, damage reduction, and preparedness activities. The benefit of CRS participation, other than the reduced cost of flood insurance premiums to policyholders, is the increased overall awareness of flood hazards in the community and decreased flood damages in the future.

Strategy

2.1 Introduce local jurisdictions to the Community Rating System (CRS) and assist them in applying for CRS certification for their communities.

Action 3: Improve storm water management throughout the region.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Action Statement: Development, whether in or out of the floodplain, has the potential to increase flooding throughout the watershed. Without due consideration of storm water management, development can increase runoff, causing areas previous unaffected by flooding to become flooded and flood depths to increase in other areas.

Strategies

3.1 Consider conducting a Regional Storm Water Management Study which would guide the localities in developing the most cost-effective storm water management system, not only within the political boundaries of each locality, but within the locality's watershed.

3.2 All communities benefiting from a regional storm water management plan could share in the cost of preparing the plan.

3.3 Seek funding to prepare site-specific hydrologic and hydraulic studies that look at areas that have chronic and repetitive flooding problems.

3.4 Consider utilizing special utility assessment districts where property owners who directly benefit from a specific pubic improvement are charged a fee that is proportional to the benefits received.

Action 4: Implement watershed planning programs and conduct watershed analysis studies.

Hazard: Flood/Hurricane, Karst/Sinkholes
Location: Region-wide
Category: Prevention

Action Statement: While it is important for communities to plan and take responsibility for the land uses that occur in their own floodplains, it must be recognized that flooding and water quality can be affected by land use activities that occur elsewhere. In order to address the wide range of water quality, water quantity and stream stability problems that exist in our Region an integrated approach is needed. Watershed planning allows localities to look holistically at water resource problems beyond jurisdictional lines.

Strategies

4.1 Develop a regional, broad-based watershed plan among localities within a watershed in order to achieve effective and long-term flood protection and a healthy riverine environment.

4.2 Develop a watershed partnership, i.e. watershed roundtable to coordinate planning and program activities among natural resource agencies and stakeholders.

4.3 Conduct a site analysis mapping study to determine and understand the karst topography in our region.

Action 5: Increase awareness of flood insurance and the National Flood Insurance Program (NFIP).

Hazard: Flood/Hurricane
Location: Region-wide
Category: Prevention

Action Statement: Insurance does not prevent disaster damage, but it provides financial protection to support recovery, repairs and reconstruction. All 21 localities in the Region participate and are in good standing with the National Flood Insurance Program (NFIP). This program is designed to provide flood insurance at affordable rates to policyholders. In return, the local jurisdictions agree to adopt and administer local floodplain management measures directed at protecting lives, existing property and future construction from future flooding. Only about 25% of the structures in our region that are in the floodplain are covered by flood insurance.

Strategies

5.1 Encourage communities to remain active and compliant with the NFIP program.

5.2 Encourage citizens to purchase flood insurance. Partner with insurance companies, lenders, and real-estate agents to market the NFIP program.

5.3 Conduct NFIP training workshops for insurance providers.

Action 6: Reduce the impact of natural disasters on private residential properties.

Hazard: Flood/Hurricane, Wildfires, Tornado/Wind, Winterstorms
Location: Region-wide
Category: Property Protection

Action Statement: There are hundreds of residential structures located in hazardous areas, particularly the floodplain, throughout our region. Most of these structures were built in the floodplain or other vulnerable areas before the enactment of zoning ordinances and other regulations that prohibited building in these areas. For these existing as well as new structures, there are numerous measures that can be taken to reduce the impact of disasters.

Strategies

6.1 Develop a program to elevate, relocate, floodproof or acquire flood-prone houses in order to provide protection to these homes and reduce future damages.

6.2 Continue residential buyout and elevation projects of identified structures most at risk of future flooding with priority given to houses that are repetitively flooded.

6.3 For properties where elevation, relocation or acquisition is not feasible, introduce retrofitting measures to protect existing structures from flood damage. Retrofitting is relatively inexpensive and can include dry floodproofing, wet floodproofing, installing sewer backflow valves, berms, and sump pumps.

6.4 Design and landscape structures with wildfire safety in mind by utilizing fire-resistant materials when building especially in the urban-wilderness interface areas. Create safety and defensible space around structures. Provide adequate water resources/dry hydrants nearby woodland communities. Improve access for fire trucks and equipment. Increase knowledge of controlled burns and use of fire-retardant vegetations.

6.5 Include in local building codes a requirement for manufactured home tie downs and hurricane straps in high wind hazard and flood prone areas.

6.6 Offer financial incentives such as tax abatements, conservation easements, and low-interest loans to encourage property owners to elevate, relocate, or floodproof buildings.

6.7 Encourage property owners to take advantage of NFIP's Increased Cost of Compliance (ICC). ICC helps pay for the cost of mitigation, including demolition and relocation, up to $15,000 for a flood- insured structure that sustains a flood loss and is declared to be substantially or repetitively damaged.

6.8 Provide guidance and technical assistance to citizens about measure they can take on their own to protect their properties.

6.9 For properties located in known karst and landslide areas, use corrective measures recommended by a professional site analysis (geotechnical or structural engineer) to protect homes.

6.10 Encourage developers to integrate mitigation techniques into new construction and renovation.

Action 7: Improve disaster education and planning services for persons with special needs.

Hazard: All Hazards
Location: Region-wide
Category: Public Education and Awareness

Action Statement: Our region is home to many persons with special needs. A number of state-run facilities, assisted living facilities, group homes, retirement communities, nursing homes, and other agencies that serve persons with special needs are also in our region. Persons with special needs are dramatically affected by disasters and include persons with medical issues, physical and mental disabilities, visual and hearing impairments, and the elderly. Non-English speaking citizens and pet owners are also considered to have special needs as well. Education programs and planning are essential to helping persons with special needs minimize the effects of disasters on their lives and homes.

Strategies

7.1 Educate persons with special needs on disaster preparedness and mitigation methods at community events and through public awareness campaigns.

7.2 Provide disaster preparedness and mitigation materials in alternate formats such as large print, audio-cassette, and languages other than English to make materials accessible for a wider audience in the community. Also provide sign language interpreters at community events, workshops, and other educational programs.

7.3 Work with the first responder community to educate them about the special needs that people may have during a disaster.

7.4 Encourage persons with special needs to contact their local emergency management office so their needs can be noted in the 911 system.

7.5 Offer emergency sheltering for persons with disabilities that can provide accommodations that take into account their special needs including the use of medical equipment requiring electrical power, etc.

7.6 Provide training in emergency operations planning and preparedness to organizations that serve persons with special needs to reduce down-time in service provision, to protect lives of staff and clients, and to reduce damage to facilities.

7.7 Work with emergency managers to make sure that weather alerts and warnings are in accessible formats for all citizens to receive essential information during a disaster.

7.8 Ensure that emergency vehicles are accessible for persons with special needs and available to assist in evacuation if needed.

7.9 Educate pet owners and farmers so they will include their pets and livestock in their family's preparedness planning.

7.10 Work with local animal welfare organizations to provide emergency sheltering for pets and livestock.

Action 8: Reduce the impact of natural disasters on commercial property and businesses.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Property Protection

Action Statement: Many of the Region's older commercial districts, downtowns, and factories were built near the water. In particular are the Cities of Waynesboro and Buena Vista, in which businesses and industry have been flooded many times costing millions of dollars in property damage, lost revenue and jobs. Projects that provide funds to floodproof and retrofit commercial buildings would not only provide protection from future flooding but could also preserve the downtown commercial districts.

Strategies

8.1 Identify and seek funding to provide engineering and design services that would determine the most cost-effective mitigation option for each business.

8.2 Seek funding to floodproof and retrofit commercial buildings where acquisition and elevation are not feasible.

8.3 Sponsor workshops that educate local business and industry about mitigation measures they can install to protect their structures and inventory during a disaster.

8.4 Develop a program to assist local business and industry in developing emergency and business continuity plans.

Action 9: Improve community warning systems in the region.

Hazard: Flood/Hurricane, Wildfire, Winter Storms Tornadoes/Wind
Location: Region-wide
Category: Emergency Services

Action Statement: Many of localities participate in a flood warning system developed by the National Weather Service called the Integrated Flood Observing and Warning System (IFLOWS). There are numerous IFLOW stream and rain gauges located throughout our Region. Two of our jurisdictions (Rockingham County and the City of Waynesboro) have "Reverse 911" systems installed. This system allows the locality to alert property owners, businesses, and industry of impending emergencies such as a chemical leak, tornado, flood, etc. through a recorded telephone message. Both the IFLOW and Reverse 911 systems are excellent and effective means to warn citizens of impending disasters. However, not all areas of our Region are covered sufficiently and effectively by this technology.

Strategies

9.1 Identify areas with recurring flood problems and request additional IFLOW stream/rain gauges to ensure that these areas are adequately covered and monitored. Areas that would benefit from an early warning system include the Greenlee Bridge on the James River near Natural Bridge Station in Rockbridge County.

9.2 Develop Emergency Action Plans for specific sites such as mobile home parks, apartment complexes, assisted living facilities, industrial facilities and essential public facilities within disaster-prone areas and develop specific warning or notification plans for each identified site. These plans should include the designation of a point of contact or resident coordinator, with alternates, to receive warnings, the dispatch of police, sheriff, fire rescue units to these sites to issue warnings and pre-designation of routes. These specific warnings will supplement the general television or radio warnings, which most people receive.

9.3 Seek funding to purchase, install, and maintain Reverse 911 emergency warning systems and other state-of-the-art disaster response and recovery equipment.

9.4 Encourage businesses and public facilities located in high hazard areas to purchase NOAA Weather Radios. By receiving early notification of potential inclement weather, businesses and public facilities can benefit from additional time to prepare for natural disasters. Local governments may be eligible for grants to purchase equipment to be distributed in public facilities, businesses, and industries through out their jurisdictions.

9.5 Utilize emergency preparedness and evacuation plans for people living in high-hazard areas, especially people with special needs and mobility impairments.

Action 10: Increase protection of public utilities and critical facilities.

Hazard: Flood/Hurricane, Wildfire, Winter Storms, Tornados/Wind
Location: Region-wide
Category: Structural Protection

Action Statement: Most communities provide some public utility service such as water, sewer and stormwater systems. Most of these facilities have been upgraded to meet environmental protection design criteria and to remain operational during a disaster. However, in some instances these facilities have failed or services have been disrupted.

Strategies

10.1 Evaluate and provide retrofit measures to prevent disruption of services. Measures can include elevating electrical controls and equipment and installing watertight doors where practicable at water and wastewater treatment plants.

10.2 Bury underground lines deeper and further away from waterways with stronger encasements in floodprone areas with erodible soils.

10.3 Increase the number of wind-secured critical facilities including schools, daycares, hospitals, and shelters.

10.4 Increase number of functional backup generators at critical facilities.

10.5 Establishing routine schedule for trimming trees/limbs around power lines to prevent power outages during wind events and ice storms.

10.6 Limit government spending on infrastructure in high hazard areas.

10.7 Conduct vulnerability assessments and develop security plans on public utility systems in accordance with the Bioterrorism Act of 2002.

Action 11: Improve dam safety throughout the region.

Hazard: Flood/Hurricane, Land Subsidence
Location: Region-wide
Category: Structural Protection

Action Statement: There are 28 flood control dams in the Region built between 1954 and 1980. Many are at or near the end of their planned design life and may pose a threat to public safety. The Soil and Water Conservation Districts have the responsibility for the operation and maintenance of most of these dams. Many of the dams in our Region require significant and costly rehabilitation and maintenance.

Strategies

11.1 Examine the risks posed by dams in watersheds that drain in the Region and consider adopting ordinances to restrict development around these dams because of the potential flooding danger in areas below and behind the dams.

11.2 Consider local government funding to maintain and upgrade these dams. Require regular inspection and maintenance schedules.

Action 12: Improve storm drainage systems in the region.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Structural Protection

Action Statement: Much of the flooding problems in our Region are a result of poor drainage and inadequate infrastructure. Drainage systems are designed to provide a certain level of protection when maintained in proper condition. Systems that are not maintained on a regular basis may become clogged with debris caused by either natural events or dumping of lawn debris, appliances and other materials. To minimize the amount debris accumulation in the drainage system, a combination of public education, regulation and maintenance programs are needed.

Strategies

12.1 Support projects that call for improved ditching, replacement of inadequate and undersized culverts, enlargements of bridge openings and drainage piping needed to minimize flooding.

12.2 Develop regular maintenance programs and standard operation procedures and budget accordingly.

12.3 Encourage routine maintenance of creek beds and culverts to allow more water to be carried with special emphasis placed on culverts where there are repeated problems.

12.4 Notify property owners living along interior streams to keep the creek beds clear of debris, weeds and high grass.

Action 13: Implement stream remediation projects where needed.

Hazard: Flood/Hurricane
Location: Region-wide
Category: Structural Protection

Action Statement: Local communities in the Region recognize the importance of protecting existing bank lines and bridge substructures. This can be accomplished with rip rap or gabion revetments, flood retarding structures, bulkheads and berms and riparian buffers that have been properly designed or constructed.

Strategies

13.1 When implementing stream remediation projects consideration should be given when designing these structures and take into account stream characteristics that influence the selection of these measures such as channel width, bank height, bend radii, storm event, channel velocities and flood depth and floodplain configuration.

13.2 Obtain maintenance and access easements from property owners for annual maintenance work.

13.3 Coordinate with and support the Region's Soil and Water Conservation Districts' Emergency Watershed Protection Programs.

Action 14: Implement a disaster preparedness and mitigation education program.

Hazard: All Hazards
Location: Region-wide
Category: Public Education and Awareness

Action Statement: There are many ways that citizens and business owners can protect themselves and reduce their losses caused by natural disasters. However, many citizens, even recent victims are unaware of these measures. Listed below are a number of activities that can be implemented in the Region to increase public awareness to the hazard and mitigation actions that can be taken to reduce future damage, injury and death caused by the natural disasters.

Strategies

14.1 Develop comprehensive public information and education programs on disasters, including preparedness, recovery, mitigation and prevention. This can be accomplished through presentations, workshops and marketing materials for citizens, business, schools, local staff and elected officials in the Region. Much of this has been and can be accomplished through Shenandoah Valley Project Impact.

14.2 Develop a public education program to educate citizens about water conservation to use of water-conserving appliances and irrigation practices in agricultural areas. Written materials could be developed to teach developers and home owners about native and or drought-tolerant grasses, shrubs and trees to be planted around residential structures.

14.3 Increase public education and awareness regarding the dangers of winter storms including driving/traveling during a winter storm event. (Automobile accidents are the leading cause of death during a winter storm event.). Also, increase public awareness to health risks associated with winter storms including exposure, hypothermia, frostbite, overexertion and accidents from falling/slipping.

14.4 Encourage communities to become involved with the Department of Forestry's Firewise program. Its goal is to encourage and acknowledge action that minimizes home loss to wildfire by preparing for a fire before it occurs.

14.5 Encourage communities to become involved in the National Weather Service program "Storm Ready". This program assists communities with local safety, planning, education and communication programs needed to save lives and property before and during weather- related disasters.

14.6 Provide Community Emergency Response Team (CERT) training to citizens and maintain a CERT organization. Having an active CERT program will not only educate citizens about preparedness and mitigation measures, it will also provide a pool of trained volunteers that can assist during an emergency or disaster.

14.7 Develop a media campaign to educate the general public throughout the year about disasters when they may be likely to occur. For example a Spring campaign on tornado safety, winter storm preparedness in the Fall, and hurricane safety prior to the start of Hurricane Season. This holistic campaign would be designed to reach a multi-generational audience and would include mitigation and preparedness information.

14.8 Increase the number and use of NOAA weather radios or battery-powered radios or TVs. Improve the effectiveness of NOAA weather radios in the valley.

14.9 Utilize the services of amateur radio operators in the region.

14.10 Sponsor Hazard Mitigation Workshops designed to give information to contractors, property owners, and business owners on mitigation strategies such as acquisition, relocation, elevation, and floodproofing.

14.11 Develop Hazard Awareness programs with the local schools, youth programs, and libraries to disseminate information on natural hazards and mitigation actions. Utilize student environmental clubs to volunteer for projects.

14.12 Notify renters of homes, mobile homes, apartments that they are located in an area that is subject to flooding and should consider purchasing flood insurance for their contents. Notification could be done via lease agreements.

14.13 Establish and maintain Hazard Resource Library/ Self Help Programs on natural hazards, mitigation and safety and related topics in a central location and available to or disseminated to property owners and businesses.

14.14 Strategically place flood elevation reference markers throughout the Region in an effort to educate and remind people of historical floods. The markers could show the elevation of the high water from previous floods as well as the 100-year flood levels in a particular area.

14.15 Notify potential homebuyers of flood hazards and requirements for flood insurance. Programs should be developed with the cooperation of banks, real estate agents, and insurance agents as well as community development staff.

14.16 Implement programs to provide property owners with flood elevation certificates in order to alert them to the fact that they their property is in the floodplain.

14.17 Provide appropriate local government staff with technical expertise and training on flood protection measures, retrofitting, flood insurance, flood warning and response, etc. in order to help citizens meet and understand floodplain requirements and flood hazards.

Action 15: Improve hazard data collection and GIS for region.

Hazard: All Hazards
Location: Region-wide
Category: Public Information

Action Statement: Many of the Flood Insurance Rate Maps (FIRM) produced by FEMA are outdated - most over 15 years old - and unreliable. These maps do not always reflect man-made alterations to floodplains caused by development that can change drainage patterns and increase flood hazards. Accurate and dependable maps are critical in helping the Region develop floodplain management strategies aimed at limiting the devastation caused by floods to area businesses and residents. Improved mapping along with GIS, a

computerized mapping and analysis tool, aids in the administration of building codes, land use plans and efforts to identify risk areas and develop mitigation actions.

Strategies

15.1 Encourage communities to participate in FEMA's Cooperating Technical Partners (CTP) Program. This FEMA initiative establishes partners with local jurisdictions to develop and maintain up-to-date flood maps and other flood hazards. Mapping activities may include hydrologic and hydraulic analysis, floodplain mapping, preparation of digital FIRMs, and refinement of floodplain boundaries.

15.2 Consider creating a consortium of communities to tackle the problem of outdated FIRM maps and how to update the FIRM maps on a regional basis.

15.3 Ensure that all localities have digitized FIRM maps.

15.4 Acquire technology to assist in managing storm water, floodplain, and other land-based resources.

15.5 Utilize GIS technology to inventory at-risk infrastructure and public and private structures within at-risk areas.

15.6 Determine and map landslide/land subsidence, karst, and sinkhole vulnerable areas in the region. Archive events in a database to monitor trends and recurring sites. Coordinate with VDOT on sites impacting transportation infrastructure.

15.7 Identify and map assisted living centers, nursing homes, facilities that serve people with special needs that require additional services during disasters.

Project Prioritization

Based on recommendations of the Mitigation and Planning Committee, projects were prioritized based on cost, effectiveness and impact on the region's citizens, feasibility of implementation, and agency staff capacity. Using these criteria, projects that fall into the Public Education and Awareness category are ranked highest. This includes all of the projects that relate to Action 14: *Implement a disaster preparedness and mitigation education program*. The second highest ranked projects are those that relate to Action 6: *Reduce the impact of natural disasters on private residential properties*. The third highest ranked projects are structural projects involving storm drainage systems, Action 12: *Improve storm drainage systems in the region.*

Action Strategy	Locality	Project Description	Hazard	Priority/ Status	Responsible Party	Timeframe
1.1	Augusta County	Floodplain Ordinance – Update and revise ordinance; include floodplain overlay district to zoning ordinance.	Flood	Medium/ In-progress	County	3 years
15.1, 15.2, 15.3	Augusta County	Update FEMA's flood maps for the following areas in the County that have repetitive flooding problems: North Mountain Estates on East Dry Branch, Deerfield on Hamilton Branch, Crawford Manor at East Dry Branch, Jollette Springs on South River, near Crimora, Stuart Draft and Sherando on Back Creek, Augusta Springs on Little Calfpasture River.	Flood	Medium/ In-progress	County, FEMA	5 years, depending on funding
14.1 – 14.17	Augusta County	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Augusta County educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	County, CSPDC, Citizen Corps	Annually, depending on funding
11.1, 11.2	Augusta County	Continue study of dam risk assessment and develop special zoning and ordinance that restrict development around these dams. Seek funding to inspect, maintain, and upgrade older dams.	Flood, Land Subsidence	Medium/ In - Progress	County, USDA, SWCD, DCR	5 – 10 years after risk assessment and funding

4.1	Rockbridge County	Develop the St. Mary's/South River Watershed feasibility study – a joint project with Rockingham County and the Army Corps of Engineers to study the flooding along the St. Mary's and South River watersheds.	Flood	Medium/ In-progress	County, CSPDC, COE, NRCS	2 – 5 years, depending on funding
3.3	Staunton	Seek funding to prepare site-specific hydrologic and hydraulic studies that look at the downtown commercial/historic areas that have chronic and repetitive flooding problems.	Flood	Medium/ New	City Engineering Department	1 year, depending on funding
10.1	Staunton	Install an emergency generator at the public water supply pump station at Middle River and Gardner Springs located in the floodplain.	All-Hazards	Low/ New	City Public Works Department	1 year, depending on funding
9.3	Staunton	Increase expenditures for state-of-the-art equipment, communication systems, and heavy equipment to respond to natural disasters in an effective and efficient manner.	All Hazards	Low/ New	City Emergency Operations Department	Annually
8.2	Staunton	Provide floodproofing measures to approximately 12 commercial structures in the downtown area that have been identified as at-risk of flooding.	Flood	Medium/ New	City Planning Department	18 months after funding
12.1	Staunton	Complete construction of the Churchville Avenue storm sewer project that is vital to reducing and alleviating downstream flooding in the central business district.	Flood	High/ On-going	City Public Works Department	2 years
14.1 - 14.17	Staunton	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Staunton educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All-Hazards	High/ On-going	City, CSPDC, Citizen Corps	Annually, depending on funding

6.2	Waynesboro	Continue city-wide residential flood mitigation project that calls for the acquisition, elevation, floodproofing of more than 50 properties identified as at-risk of future flooding. Most of the these houses are located in the Club Court, Arch Ave, Market Street areas of the city.	Flood	High/ In-progress	City, Housing Authority, CSPDC	2 – 5 years depending on funding
6.2	Waynesboro	Complete the acquisition and relocation of tenants of the Race Ave Trailer Park, a 33 unit trailer park that has been repetitively and seriously damaged in numerous flood events.	Flood	High/ In-progress	City, Housing Authority, CSPDC	2 years
3.1, 3.3	Waynesboro	Up-date a master stormwater study that identifies, analyzes, and prioritizes flooding areas throughout the city.	Flood	Medium/ On-going	City, Public Works and Engineering Departments	2 – 5 years
14.1 – 14.17	Waynesboro	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Waynesboro educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	Flood	High/ On-going	City, CSPDC, Citizen Corps	Annually, depending on funding
8.1, 8.2	Waynesboro	Seek funding to implement a flood mitigation project to provide floodproofing and retrofitting measures to Waynesboro's downtown commercial area.	Flood	Medium/ New	City, Economic Development Office, CSPDC	2 years depending on funding

12.1	Craigsville	Seek funding to replace and improve infrastructure in key locations throughout the town to reduce flood damage caused by interior stream water and inadequate culverts and infrastructure. Coordinate project with VDOT.	Flood	High/ New	Town, VDOT	Within 2 years depending on funding
14.1-14.17	Craigsville	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Craigsville educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, dependent on funding
6.1	Bath County	Develop a program to elevate, relocate, floodproof or acquire floodprone structures in order to reduce or eliminate future damages with priority given to structures that are repetitively flooded. Areas of concern where flooding is repetitive include Hot Springs, Jackson River, Mill Creek, Millboro, Millboro Springs, Mountain Grove and Pads Creek.	Flood	High/ New	County, CSPDC	2 – 5 years, depending on funding
14.1 – 14.17	Bath County	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Bath County educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness	Flood	High/ On-going	County, CSPDC, Citizen Corps	Annually, depending on funding

		campaigns, and by offering Community Emergency Response Team (CERT) training.				
14.1 – 14.7	Highland County	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Highland County educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	County, CSPDC, Citizen Corps	Annually, depending on funding
14.1 – 14.17	Monterey	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Monterey educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

4.1	Rockbridge County	Develop the St. Mary's/South River Watershed feasibility study – a joint project with Augusta County and the Army Corps of Engineers to study the flooding along the St. Mary's and South River watersheds.	Flood	Medium/ In-progress	County, CSPDC, COE, NRCS	2 – 5 years, depending on funding
13.1, 13.2, 13.3	Rockbridge County	Continue the stream remediation and bank stabilization work by NRCS on the South River that was affected by Hurricane Isabel and prior flooding events.	Flood	Medium/ In-progress	County, NRCS	2 years
6.2	Rockbridge County	Complete the South River Flood Mitigation Project which calls for the acquisition of up to 35 properties along the South River that were destroyed or damaged in Hurricane Isabel.	Flood	High/ In-progress	County, CSPDC, FEMA, VDEM, DHCD	2 years
14.1 – 14.17	Rockbridge County	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Rockbridge County educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	County, CSPDC, Citizen Corps	Annually, depending on funding
6.2	Buena Vista	Seek funding to continue city-wide residential flood mitigation project that calls for the acquisition, elevation, floodproofing of properties identified as at-risk of future flooding.	Flood	High/ New	City, CSPDC	2 – 5 years depending on funding
8.1, 8.2	Buena Vista	Continue study of acquiring and demolishing the Reeves Brother plant, a major industrial site that was closed in 1985 after Hurricane Juan severely damaged the plant.	Flood	Medium/ New	City, DEQ	2 – 5 years depending on funding

12.1, 13.1, 13.3	Buena Vista	Continue the Buena Vista Watershed Project to prevent flooding from four of the interior streams that flow through Buena Vista. The project funded by USDA would protect 240 residences, 70 commercials structures and utilities by constructing debris basins, replacing culverts and bridges and improving stream channels.	Flood	High/ New	City, USDA, NRCS	2 – 5 years
14.1 – 14.17	Buena Vista	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Buena Vista educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	City, CSPDC, Citizen Corps	Annually, depending on funding
4.2, 12.3, 12.4, 13.2	Lexington	Complete the Woods Creek Restoration Project to address water quality/quantity problems along Woods Creek which runs through the City. The project includes establishing riparian buffers, controlling storm runoff, modifying existing stormwater retention facilities and educating property owners about water quality/quantity issues.	Flood	Medium/ In-progress	City, Volunteers	Annually
14.1 – 14.7	Lexington	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Lexington educates its citizens on disaster preparedness and	All Hazards	High/ On-going	City, CSPDC, Citizen Corps	Annually, depending on funding

		mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.				
12.1, 13.1	Glasgow	Seek funding to complete the Glasgow Interior Stream Drainage Project to prevent or reduce flooding along Sallings Mountain and Miller Mountain. The project calls for the construction of a debris basin, flood diversion wall, improved channelization and replacement of several culverts throughout town.	Flood	High/ New	Town	2- 5 years depending on funding
6.2	Glasgow	Seek funding to complete the Glasgow Residential Flood Mitigation Project that calls for the acquisition, relocation, elevation of approximately 10 residential properties that have been severely damaged in the past flood events.	Flood	High/ New	Town, CSPDC	2 – 5 years depending on funding
10.1, 10.7	Glasgow	Implement a project to safeguard the Town's water system and 3 municipal wells through a wellhead protection project that includes properly abandonment of unused wells, fencing and other security measures, routine inspections of utility lines, education for property owners, business, industry, and railroad.	All Hazards	Medium/ New	Town, Virginia Rural Water Association	1 – 3 years after funding
14.1 – 14.7	Glasgow	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Glasgow educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

8.1, 10.1	Goshen	Seek funding to relocate the Goshen Town Hall and Goshen Fire Department. Both of these critical facilities are located on Main Street in close proximity to Mill Creek in a low lying area that receives repeated flooding and affects the operation of the town and fire department. The town has purchased 40 acres out of the floodplain that could be used as alternative site for these critical facilities.	Flood	Medium/ New	Town	2 - 5 years depending on funding
12.1	Goshen	Replace culvert at Baptist Hill Road (State Rt. 1001) to alleviate flooding on Route 39.	Flood	High/ New	Town	1 year depending on funding
14.1 – 14.17	Goshen	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Goshen educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	Flood	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding
6.2	Rockingham County	Seek funding to continue county-wide residential flood mitigation project that calls for the acquisition, elevation, floodproofing of properties identified as at-risk of future flooding. Most of these houses are located in the Naked Creek, Rawley Springs, and Bergton/Criders area of the County.	Flood	High/ New	County, CSPDC	2 – 5 years depending on funding
14.1, 14.12, 14.17,	Rockingham County	Continue support of the Rockingham County Flood Recovery Committee, a volunteer group made up of representatives of local churches, the Red Cross, Salvation Army, United Way,	All Hazards	High/ On-going	County, human service agencies, volunteers	As needed

		VOAD, Social Services, Rockingham County and others that work with residents affected by disasters in providing assistance not covered by federal and state recovery programs.				
14.1 - 14.17	Rockingham County	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Rockingham County educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	County, CSPDC, Citizen Corps	Annually, depending on funding
13.1, 13.2, 13.3	Rockingham County	Begin the stream remediation projects sponsored by NRCS on Germany River, Naked Creek, and Dry Run River that call for streambank restoration, removal of watershed impairments and installation of debris basins to repair damage caused by Hurricane Isabel.	Flood	High/ New	County, NRCS	1 – 3 years
14.4	Rockingham County	Continue participation in Department of Forestry's Firewise Program, a community awareness and education program that encourages and acknowledges woodland communities to take action than minimizes home loss to wildfires by preparing for a fire before it occurs.	Wildfires	High/ On-going	County, VDOF	Annually, depending on funding
7.9	Rockingham County	Continue support of the Rockingham County/Harrisonburg and Rockingham SPCA emergency shelter for pets and livestock during a disaster. Volunteers trained to work with animals during disasters situations staff the shelter.	All Hazards	Medium/ On-going	County, City, SPCA	Annually, depending on funding

15.1	Harrisonburg	Continue participation in FEMA's Cooperating Technical Program (CTP), a technical assistance program sponsored by FEMA that will assist the City in re-mapping the entire floodplain boundary in the City.	Flood	Medium/ On-going	City, FEMA	1 – 3 years, depending on funding
1.5, 1.6	Harrisonburg	Complete the Blacks Run Greenway, a plan to improve Blacks Run, a six-mile creek that runs through the City of Harrisonburg, by limiting development in the floodplain, safeguarding the watershed, and creating open space.	Flood	Medium/ On-going	City, Friends of Blacks Run, volunteers	2 – 10 years, depending on funding
14.1 – 14.17	Harrisonburg	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Harrisonburg educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	City, CSPDC, Citizen Corps	Annually, depending on funding
6.2	Bridgewater	Seek funding to complete the Bridgewater Flood Mitigation Project where structures have been identified as at-risk of flooding and mitigation options such as acquisition, elevation, and/or floodproofing is recommended.	Flood	High/ New	Town	2 – 5 years depending on funding
14.1 – 14.17	Bridgewater	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Bridgewater educates its citizens on disaster preparedness and	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

		mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.				
3.3, 12.1	Broadway	Seek funding to prepare site-specific hydrologic and hydraulic studies and make recommendations for structural improvements to protect businesses and residences along Linville Creek where chronic and repetitive flooding problems occur.	Flood	High/ New	Town	1 – 3 years, depending on funding
14.1 - 14.17	Broadway	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Broadway educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding
14.1 - 14.17	Dayton	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Dayton educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

14.1 – 14.17	Elkton	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Elkton educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding
3.3, 12.1, 12.2, 12.3, 12.4	Grottoes	Complete the Grottoes Stormwater Drainage Improvement Project to address flooding caused by ponding and poor drainage along Miller Run and Dry Run. Project improvements such as ditching, replacement of undersized culverts and drainage piping will protect between 30 and 50 structures and eliminate water on roads, yards and crawl spaces.	Flood	High/ In-progress	Town	3 – 5 years depending on funding
12.1, 13.1	Grottoes	Extend earthen berm in Grottoes Town Park to provide protection to the park which periodically receives flooding form the South River.	Flood	High/ New	Town	1 – 3 years depending on funding
14.1 - 14.17	Grottoes	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Grottoes educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

14.1 - 14.17	Mt. Crawford	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Mt. Crawford educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding
14.1 – 14.17	Timberville	Continue membership and participation in Shenandoah Valley Project Impact, the regional disaster preparedness and mitigation education program, started in September 2000, which currently serves as the Citizen Corps Council for the Region. As a community active in Shenandoah Valley Project Impact, Timberville educates its citizens on disaster preparedness and mitigation at community events, through workshops and training, with public awareness campaigns, and by offering Community Emergency Response Team (CERT) training.	All Hazards	High/ On-going	Town, CSPDC, Citizen Corps	Annually, depending on funding

VI. PLAN MAINTENANCE

According to the Disaster Mitigation Act of 2000 local plans are required to include a method and schedule of monitoring, evaluating, and updating the hazard mitigation plans within a five-year cycle as well as a description of continued public involvement in the hazard mitigation planning process.

The Central Shenandoah Valley Region will use its Citizen Corps Council as the body responsible for the review, monitoring and update of its All Hazards Plan provided sufficient funding is available. This group meets on a quarterly basis (3rd Tuesday of each quarter) and includes representatives from numerous agencies, local government and nonprofit organizations throughout our region. In the event that the Citizen Corps Council shall dissolve then each local jurisdiction will be responsible for the maintenance and update of the Plan.

The mission of our Citizen Corps Council is to empower individuals through education, training, and volunteer service to make communities safer, stronger, and better prepared for natural and man-made disasters. Our local Citizen Corp Council also promotes and strengthens programs at the community level, such as Community Emergency Response Team (CERT) programs; develops targeted outreach for special needs groups; organizes special projects and community events; and encourages cooperation and collaboration among community leaders. Our Citizen Corps Council is staffed by the Central Shenandoah Planning District Commission with funding provided through the Department of Homeland Security and local jurisdictions.

Through our Citizen Corps Council, the All Hazards Plan will be reviewed on an annual basis and updated when and where needed. Each local jurisdiction will be asked to review the Plan and submit a report that outlines any revisions, projects, or activities that impact the Plan. These annual reports will be reviewed by the Citizen Corps Council and revisions will be made to the Plan. In addition any local, state, or federal regulations that change or impact the Plan will be incorporated into the Plan. Local governments will be apprised of any substantial changes to the Plan.

In addition to an annual review by the Citizen Corps Council, local governments will asked to include the All Hazards Plan in their Emergency Operations Plan (EOP). The Virginia Emergency Management and Disaster Law of 2000 require that the State, and each county and city within the State develop and maintain a current Emergency Operation Plan which addresses their planned response to extraordinary emergency situations. As part of the basic EOP, an appendix that addressees hazard mitigation activities is required. We will request that each of our cities and counties included the Central Shenandoah All Hazards Mitigation Plan as part of their EOP's Hazard Mitigation Annex and request local government review of the All Hazard Plan as part of their annual EOP review. In addition, a request will be made to each local jurisdiction to include the All Hazards Plan in other planning documents such as comprehensive plans and capital improvement plans.

The Plan will undergo a comprehensive review every 5 years. The Citizen Corps Council will be the entity responsible for the review, evaluation and up-date of the Plan. The criteria used to evaluate the plan will be developed in accordance with the requirements of the Federal Emergency Management Agency (FEMA) Section 322 local hazard mitigation planning regulations as well as additional guidance documents provided by FEMA and Virginia Department of Emergency Management. The method used to up-date the Plan will include a request from each jurisdiction for a report that describe the progress of mitigation strategies identified in the Plan and any activities or projects that has been implemented. Other factors that could necessitate a revision to the Plan may include any new local, state, or federal regulations or requirements that impact the Plan; any Presidentially-declared disasters that have impacted the region, or an increase or decrease in a communities' vulnerability to a natural disaster. The 5-year update will be submitted to each of the local governments, the Virginia Department of Emergency Management, and FEMA as required. Significant changes to the Plan will require a public hearing.

Public participation was an integral part of the development of this Plan and will continue through the course of its existence. Activities to involve the public in the maintenance, evaluation and revision of the plan may include quarterly Citizen Corps Council meetings where the general public is invited, utilizing the websites of the Central Shenandoah Planning District Commission to notify the public of meetings, agendas, and revisions of the Plan, utilizing the media to notify the public of any up-coming activities or public hearings regarding the Plan and the Plan update.

VII. ADOPTION PROCESS AND DOCUMENTATION

The Central Shenandoah Valley Regional All Hazards Mitigation Plan was developed as a multi-jurisdictional plan; therefore, to meet the requirements of Section 322 of the Disaster Mitigation Act of 2000, the final plan was adopted by each of the 21 municipalities in our Region. Resolutions are included in Appendix C.

VIII. REFERENCES

Other Mitigation Plans:

- Virginia Department of Emergency Management (VDEM) Commonwealth of Virginia's Standard Hazard Mitigation Plan (2004).
- Cumberland Mitigation Plan
- NRV Mitigation Plan
- Wyoming County (WV) Mitigation Plan

Websites:

- US Census Bureau – American Fact Finder: http://www.census.gov
- www.dof.virginia.gov

Software:

- FEMA HAZUS software
- ESRI data and software
- PRISM Data
- Data provided by Whitt Sours (GIS CSPDC)
- FEMA FIS – for community descriptions and flooding/hurricane events

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Institute for Infrastructure and Information Assurance James Madison University. Ken Newbold and Josh Barnes presentation at CSPDC Project Impact on November 16, 2004.

Department of Mines and Minerals, Karst Mapping